2023 COASTAL MASTER PLAN
COMMITTED TO OUR COAST

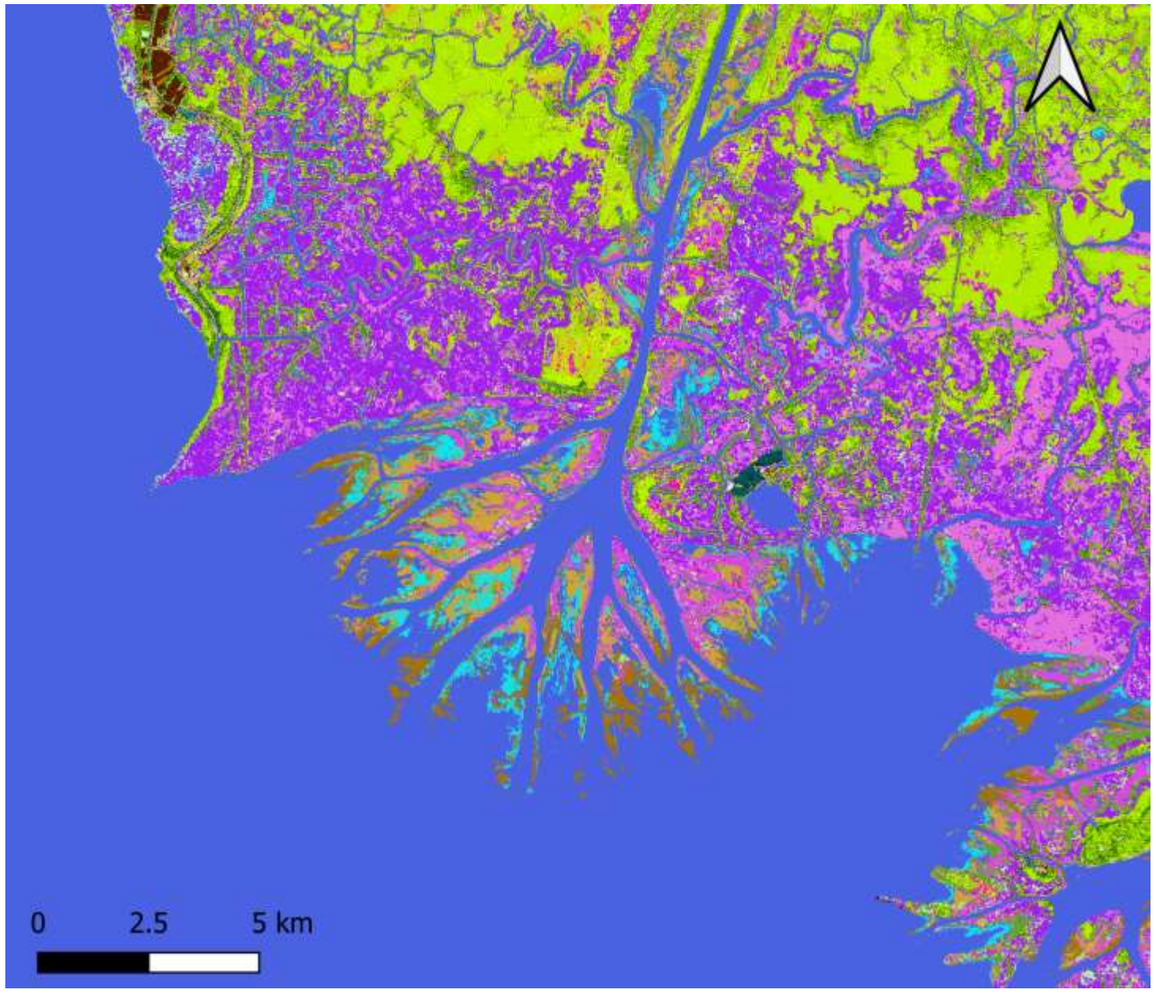
ICM-MORPH & ICM-LAVEGMOD

MADDIE FOSTER-MARTINEZ

DECEMBER 15, 2020

INTEGRATED COMPARTMENT MODEL (ICM)

- ICM-LAVegMod
  - Models coverage of 43 vegetation species and bareground
- ICM-Morph
  - Models elevation changes across all wetlands and open water



Example from the land use land cover dataset in the Wax Lake Delta region. Different colors represent different vegetation coverages.

INTEGRATED COMPARTMENT MODEL (ICM)

ACKNOWLEDGEMENTS

Wetlands, Vegetation, and Soil Team: (by organization)

- Water Institute
  - Melissa Baustian
- USGS
  - Hongqing Wang
  - Gregg Snedden
- CPRA
  - Elizabeth Jarrell
  - Tommy McGinnis
  - Leigh Anne Sharp
  - Eric White
- UNO
  - Denise Reed
  - Maddie Foster-Martinez
- ULL
  - Jenneke Visser
  - Scott Duke-Sylvester
- LSU
  - Kristin DeMarco

ICM-LAVegMod

- Original Developers:
  - Jenneke Visser
  - Scott Duke-Sylvester
- Additional Developer:
  - Maddie Foster-Martinez

ICM-Morph

Original Developer:

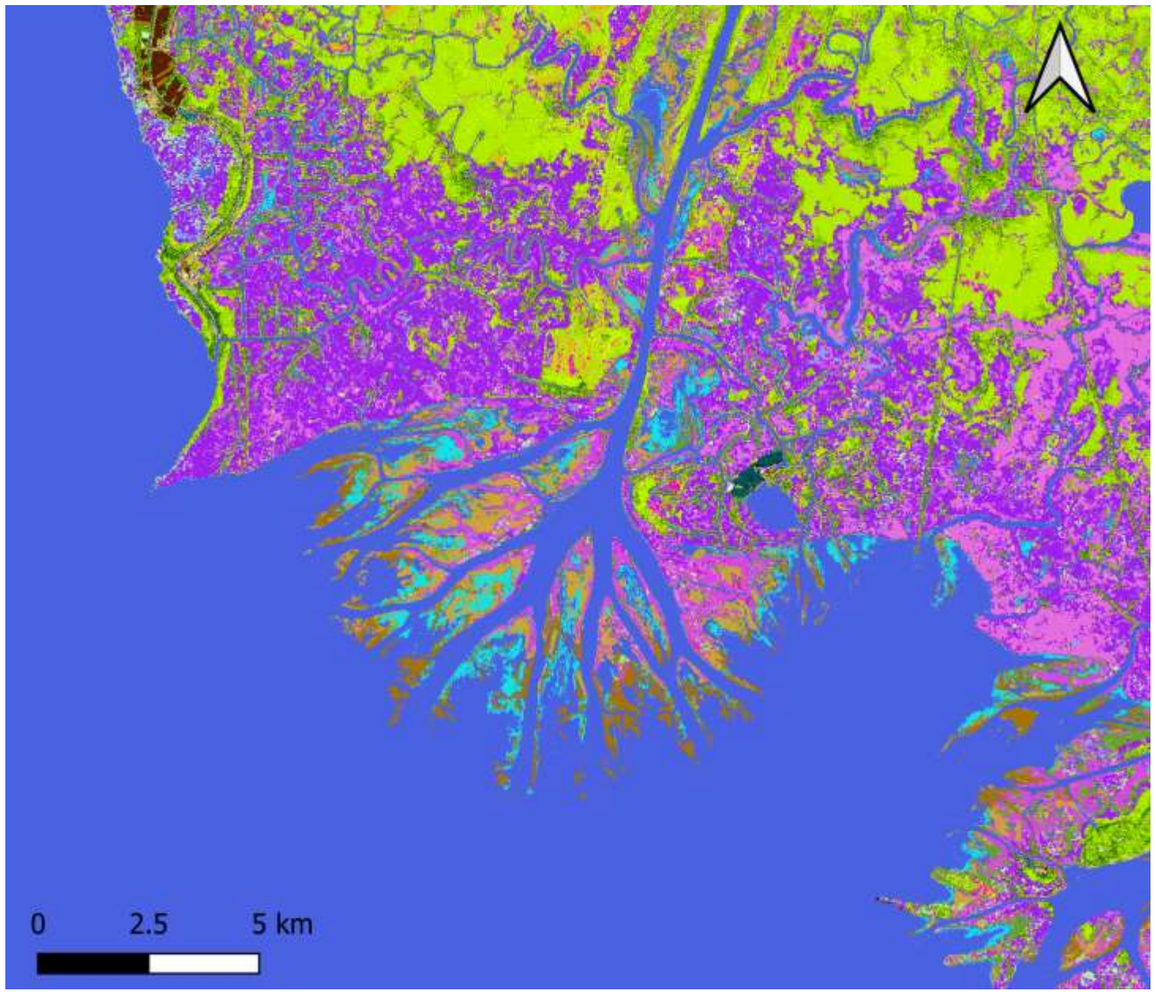
- Brady Couvillion

- Additional Developer:
  - Eric White

INTEGRATED COMPARTMENT MODEL (ICM)

- ICM-LAVegMod
  - Models coverage of 43 vegetation species and bareground
  - Operates on a 480 m x 480 m grid (boxes)

- ICM-Morph
  - Models elevation changes
  - Operates on a 30 m x 30 m grid (cells)



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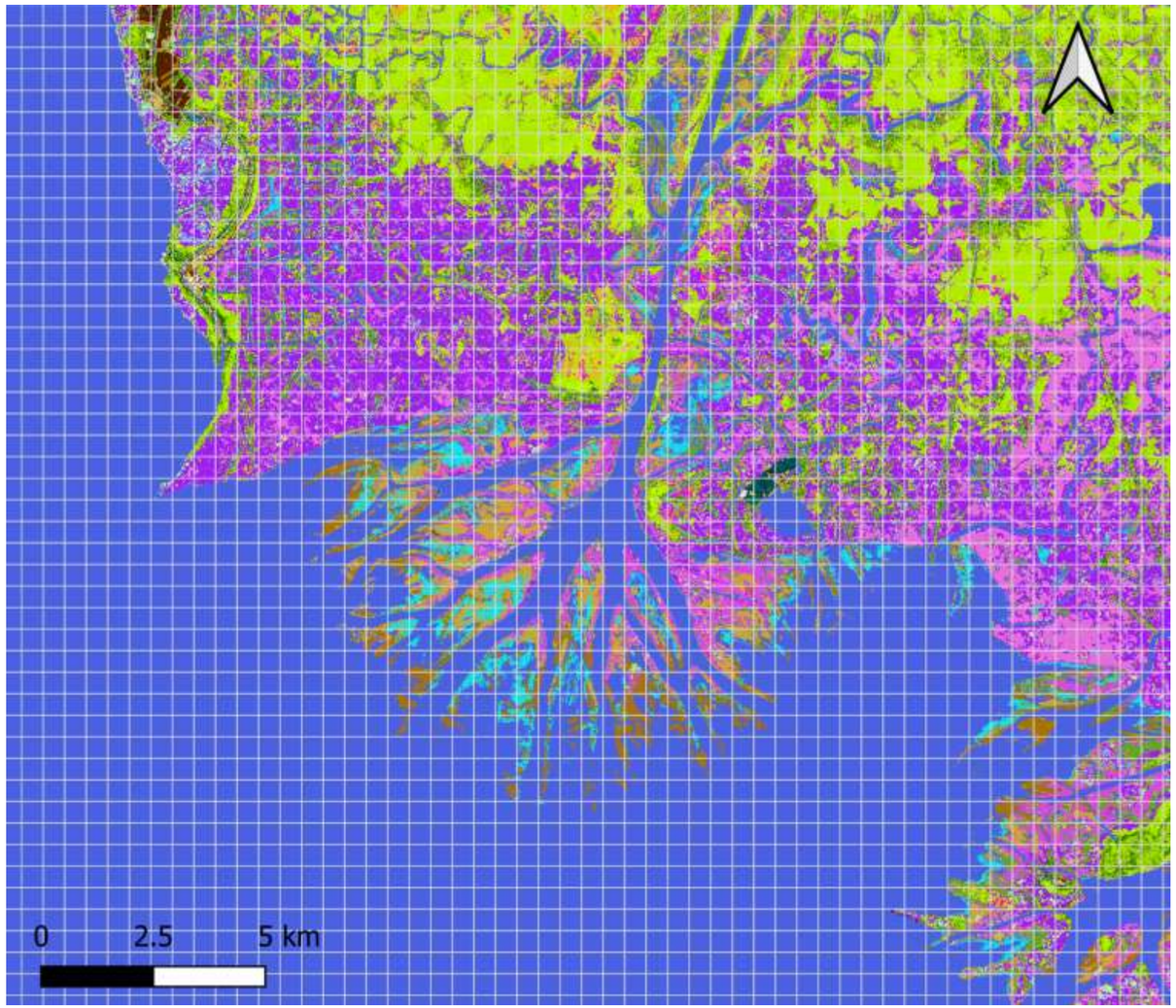

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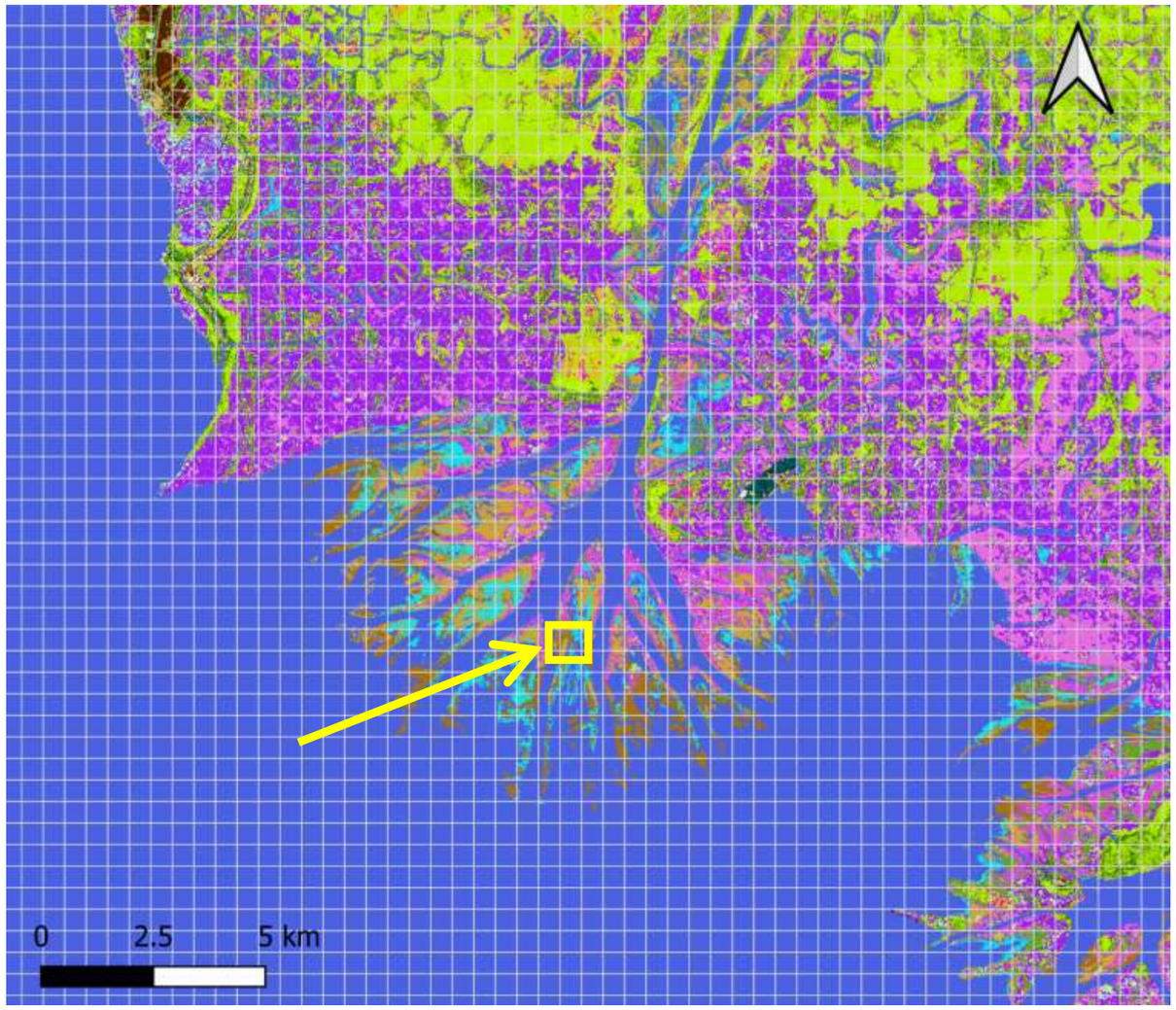

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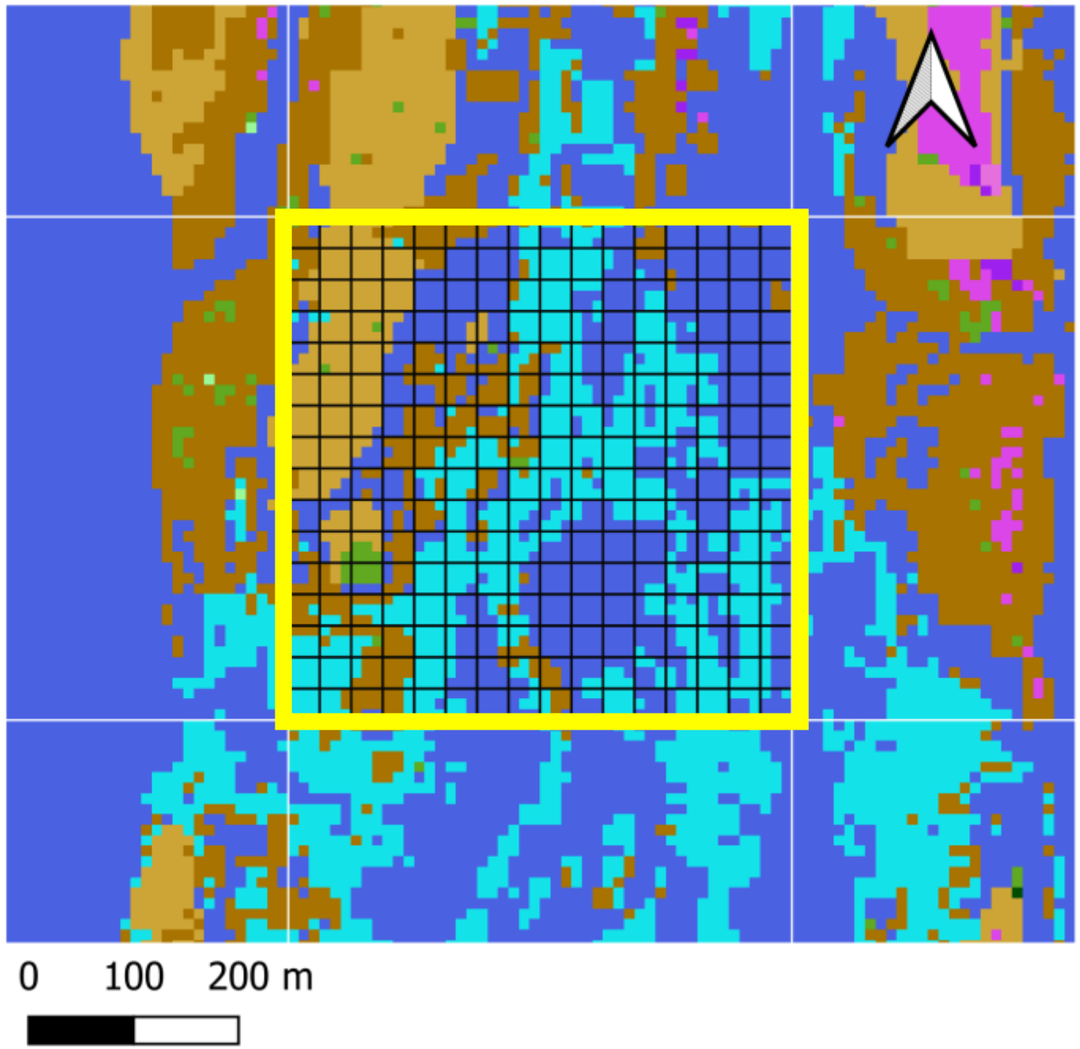
- ICM-Morph
  - Models elevation changes
  - Operates on a 30 m x 30 m grid (cells)
  - 256 ICM-Morph cells in every ICM-LAVegMod box



Example from the land use land cover dataset in the Wax Lake Delta region. Different colors represent different vegetation coverages. White lines show the ICM-LAVegMod grid. Black lines show the ICM-Morph grid.

ICM-LAVEGMOD

SPECIES MODELED

Flotant

- *Eleocharis baldwinii*
- *Panicum hemitomon*

Bottomland Hardwood

- *Quercus laurifolia*
- *Quercus lyrate*
- *Quercus nigra*
- *Quercus texana*
- *Quercus virginiana*
- *Ulmus americana*

Swamp Forest

- *Nyssa aquatica*
- *Salix nigra*
- *Taxodium distichum*

Fresh Marsh

- *Colocasia esculenta*
- *Morella cerifera*
- *Panicum hemitomon*
- *Sagittaria latifolia*
- *Zizaniopsis miliacea*

Intermediate Marsh

- *Cladium mariscus*
- *Eleocharis cellulose*
- *Iva frutescens*
- *Paspalum vaginatum*
- *Phragmites australis*
- *Polygonum punctatum*
- *Sagittaria lancifolia*
- *Schoenoplectus californicus*
- *Typha domingensis*

Brackish Marsh

- *Schoenoplectus americanus*
- *Schoenoplectus robustus*
- *Spartina cynusuroides*
- *Spartina patens*

Salt Marsh

- *Avicennia germinans*
- *Distichlis spicata*
- *Juncus roemerianus*
- *Spartina alterniflora*

Barrier Island

- *Uniola paniculate*
- *Strophostyles helvola*
- *Sporobolus virginicus*
- *Spartina patens*
- *Solidago sempervirens*
- *Panicum amarum*
- *Distichlis spicata*
- *Baccharis halimifolia*

ICM-LAVEGMOD: SPECIES ATTRIBUTES

- Each vegetation species has four attributes:
  - Probability of mortality given environmental conditions
  - Probability of establishment given environmental conditions
  - FFIBS value (salinity value)
  - Dispersal class
- Attributes are set inputs and do not change over time

ICM-LAVEGMOD: SPECIES ATTRIBUTES

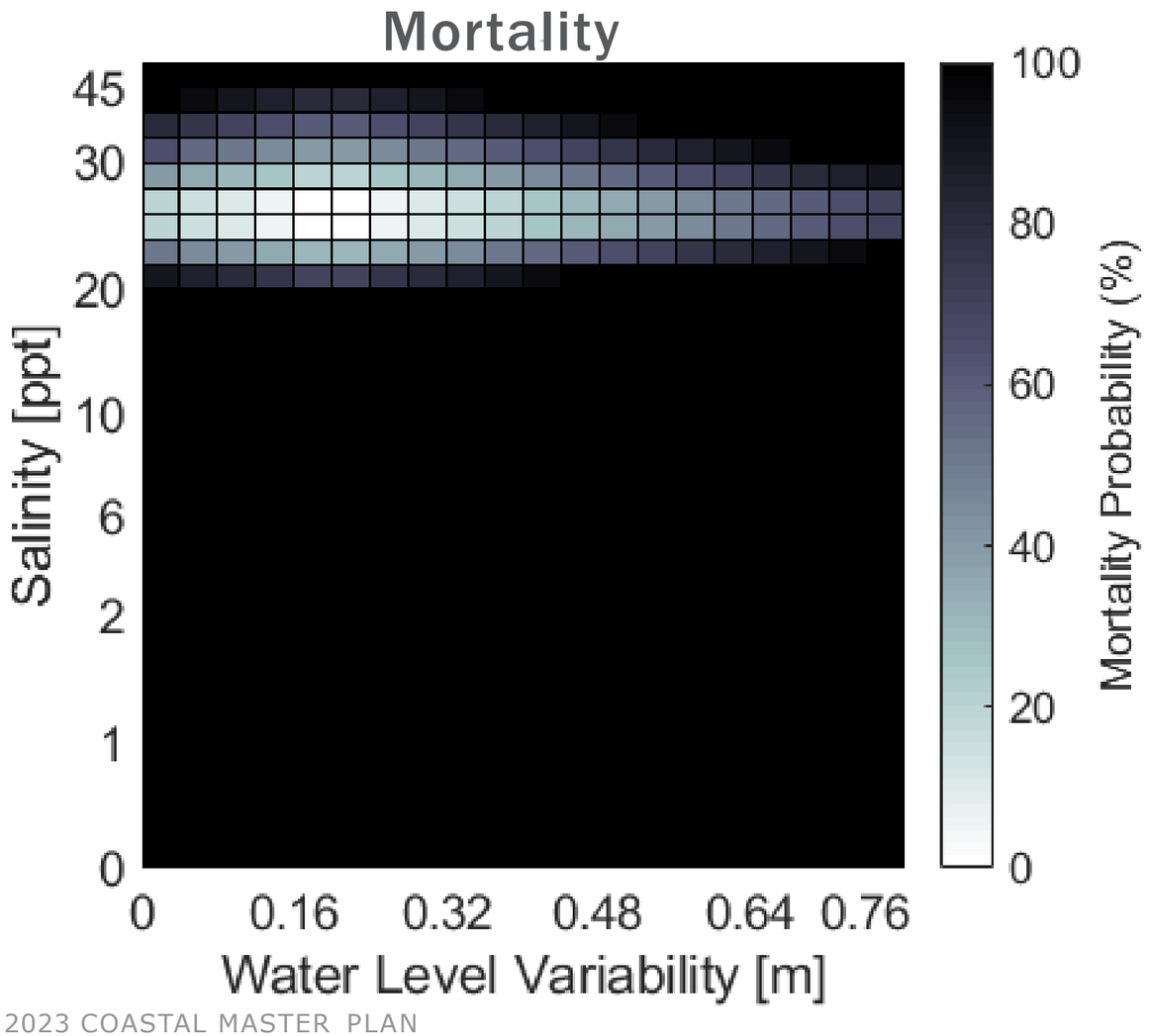
MORTALITY AND ESTABLISHMENT TABLES

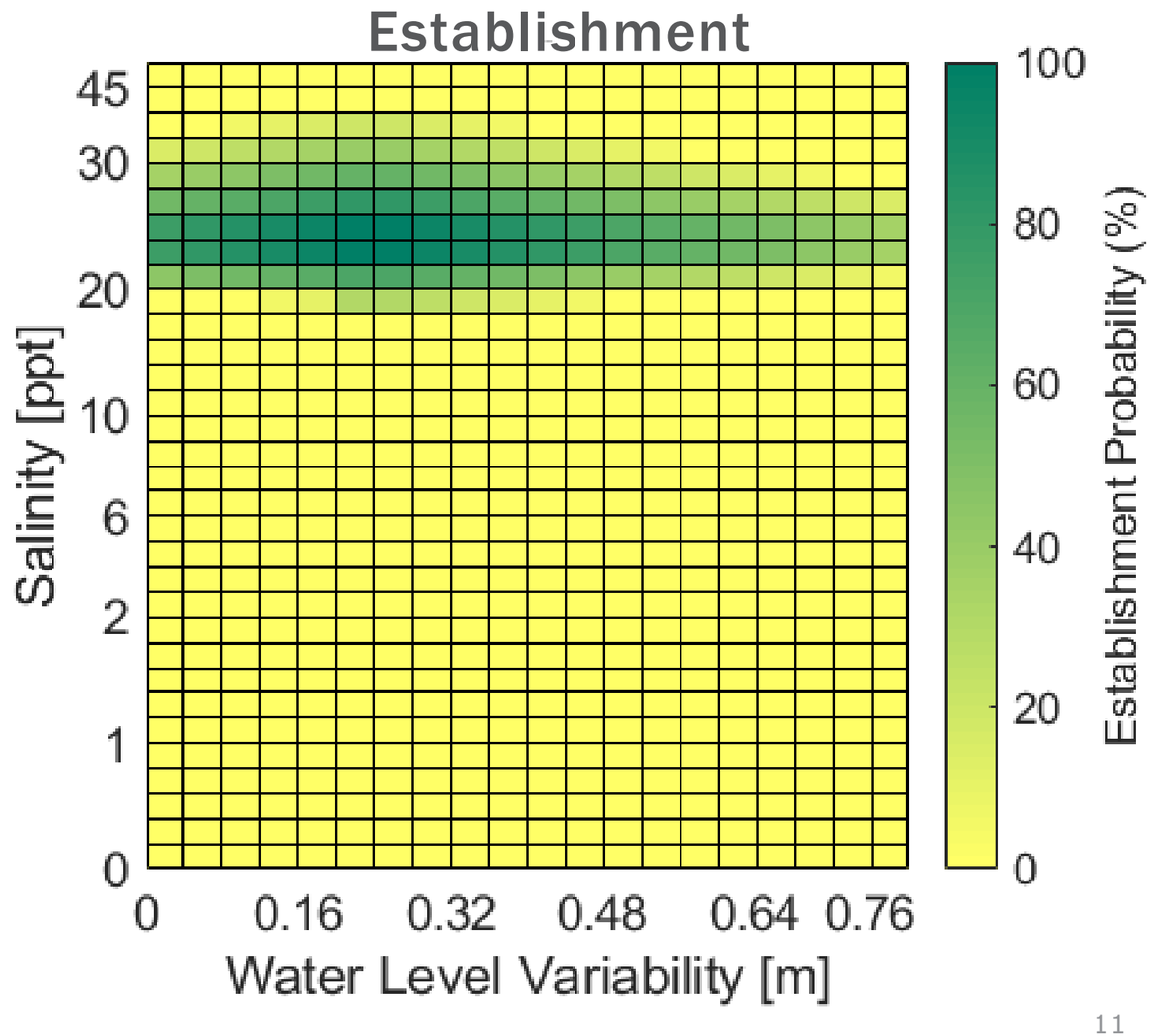
- Every vegetation species has a probability of mortality and probability of establishment
- These probabilities are based on CRMS data
- The probabilities for Bottomland Hardwood species are determined by the ground elevation
- The probabilities for all other species are determined by the mean annual salinity and the water level variability

ICM-LAVEGMOD: SPECIES ATTRIBUTES

SPECIES ATTRIBUTES: MORTALITY AND ESTABLISHMENT TABLES

- Example from black mangrove (*Avicennia germinans*)

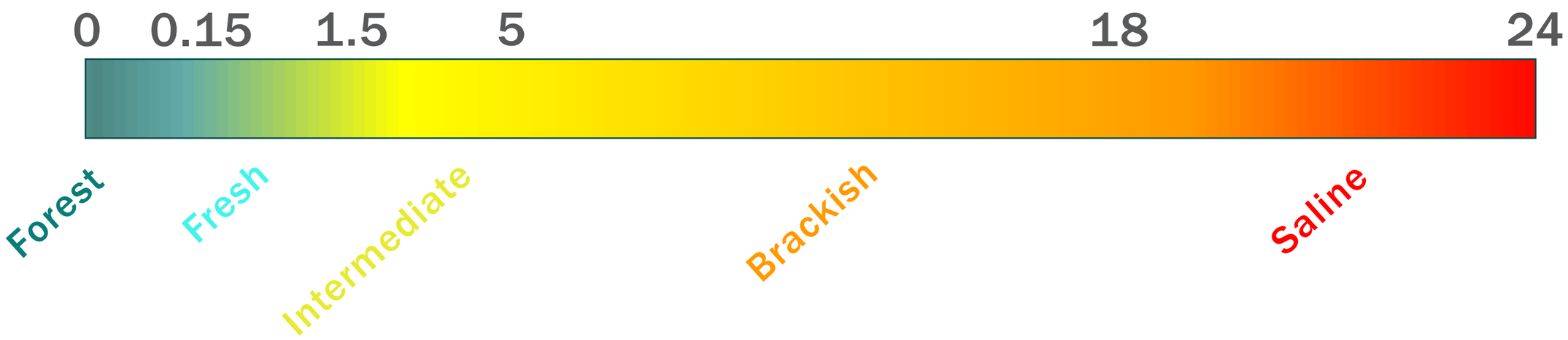




ICM-LAVEGMOD: SPECIES ATTRIBUTES

FFIBS SCORE

- Every vegetation species is given a value based on salinity regime

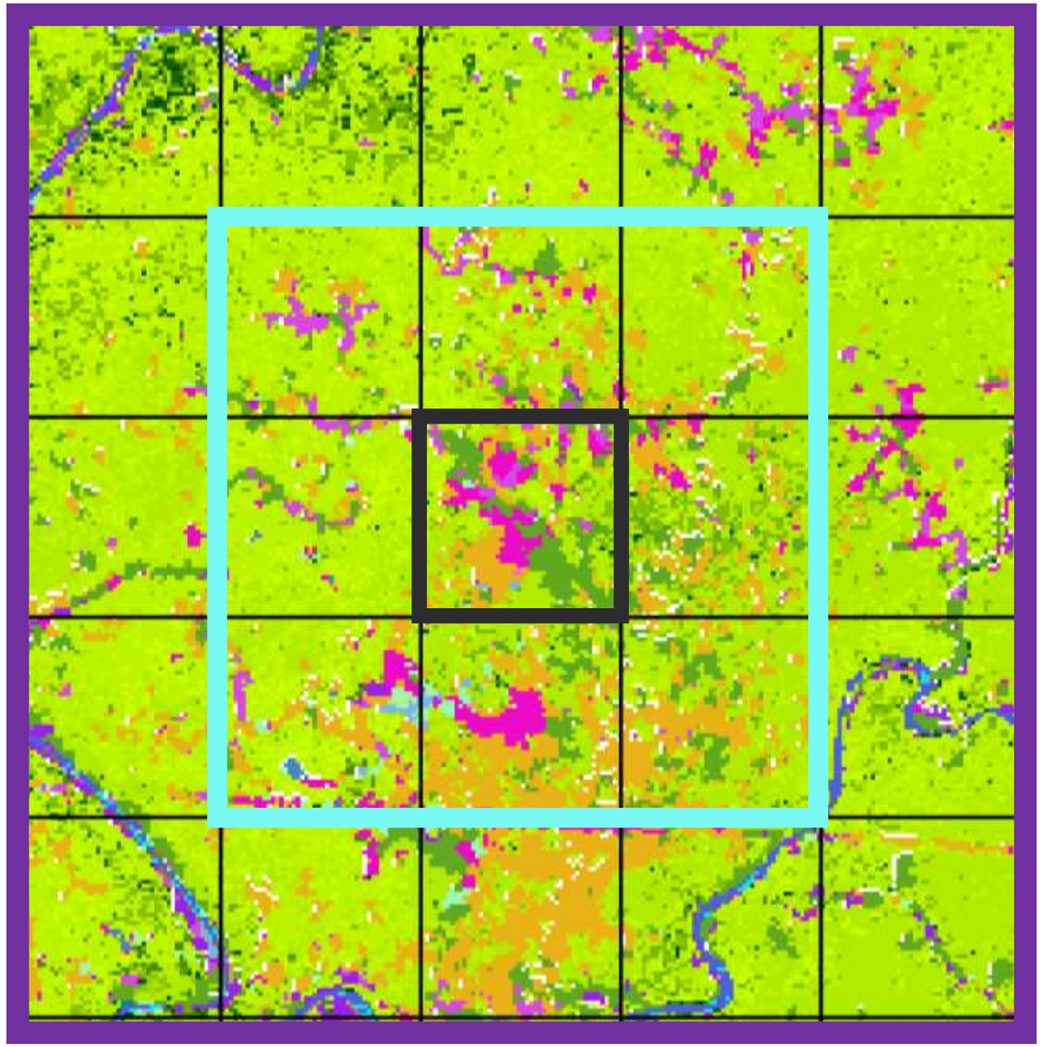


- A FFIBS score is calculated for each ICM-LAVegMod grid box
- The FFIBS score is an average of the FFIBS values weighted by the area occupied by each species

ICM-LAVEGMOD: SPECIES ATTRIBUTES

DISPERSAL CLASS

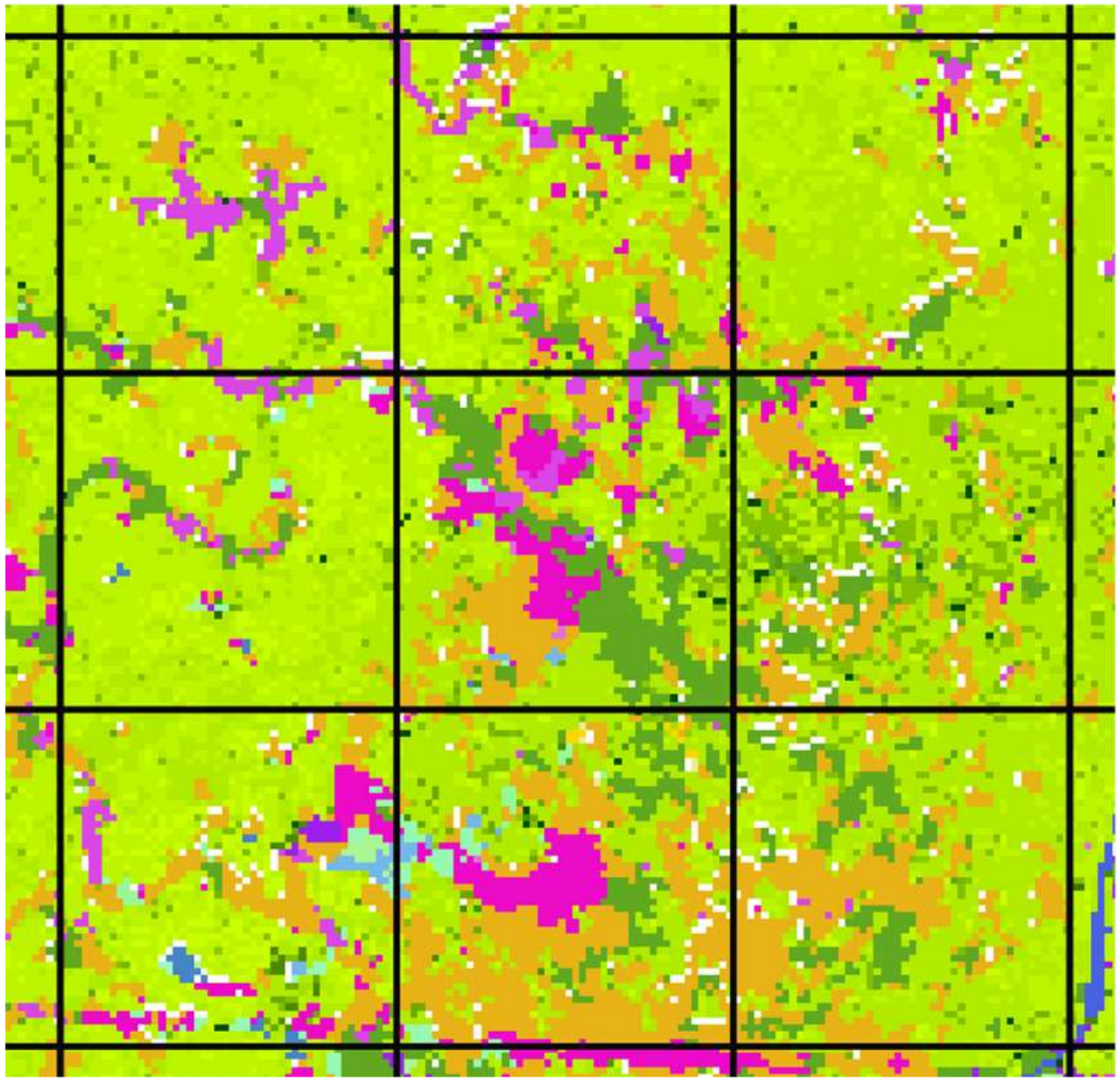
- The dispersal class describes how far a species can spread as conditions change
- Three classes:
  - Low = Can move 1 box
  - Medium = Can moved 2 boxes
  - High = Can move anywhere
- The ability to establish on bareground is based off both establishment probability and how abundant the species is in the area



Example from the land use land cover dataset. Different colors represent different vegetation coverages. Black lines show the ICM-LAVegMod grid. The blue box bounds the spread area for low dispersal class species, and the purple box bounds the spread for medium dispersal species.

ICM-LAVEGMOD: INITIAL CONDITIONS

- Map of 2018 land use land cover (LULC) is used to create the initial vegetation coverages (10 m resolution)
- The coverage of every species is summed in each ICM-LAVegMod grid box



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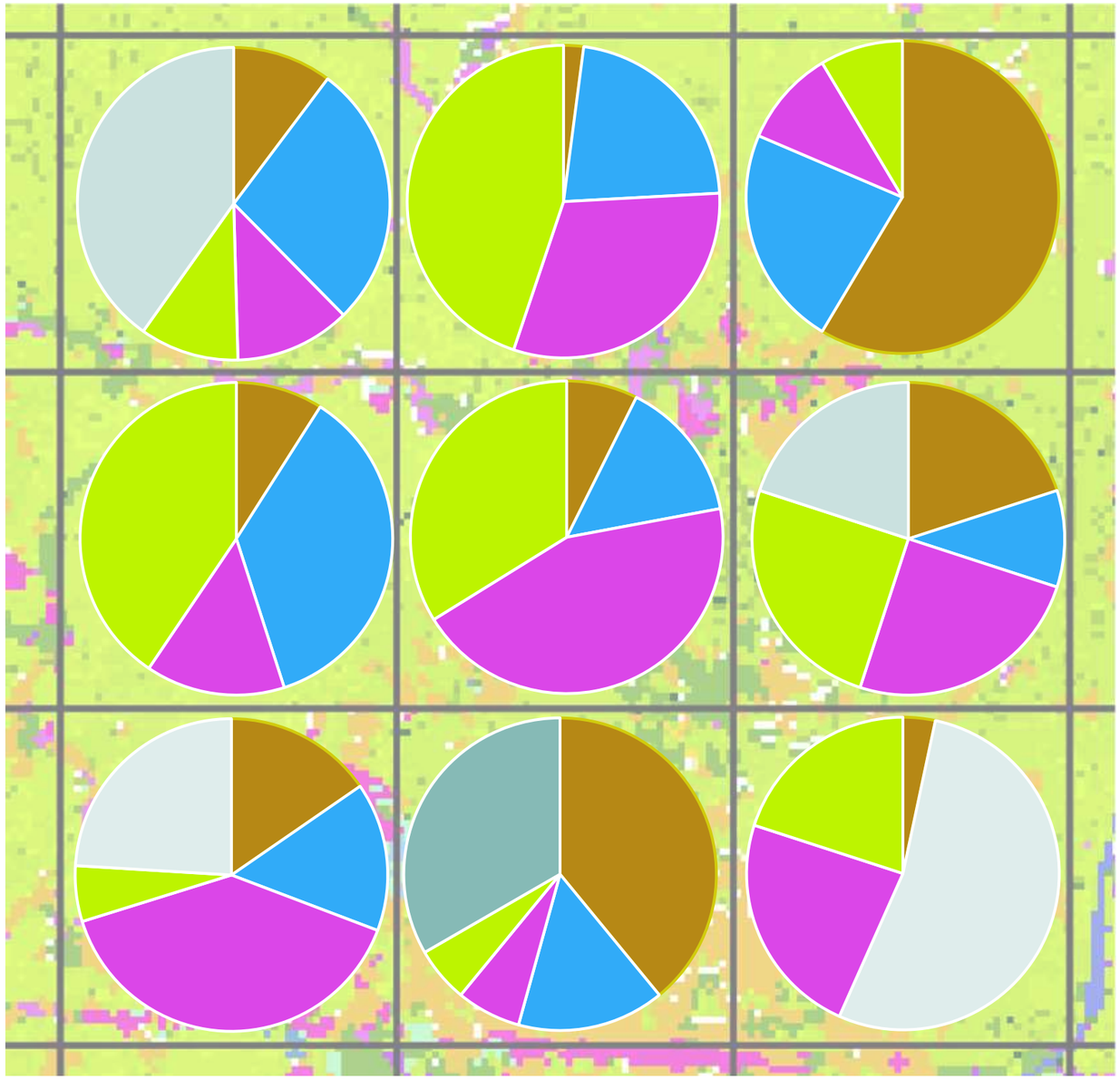

Pie charts represent the coverage percentages of every species within each ICM-LAVegMod grid box.

ICM-LAVEGMOD: INITIAL CONDITIONS

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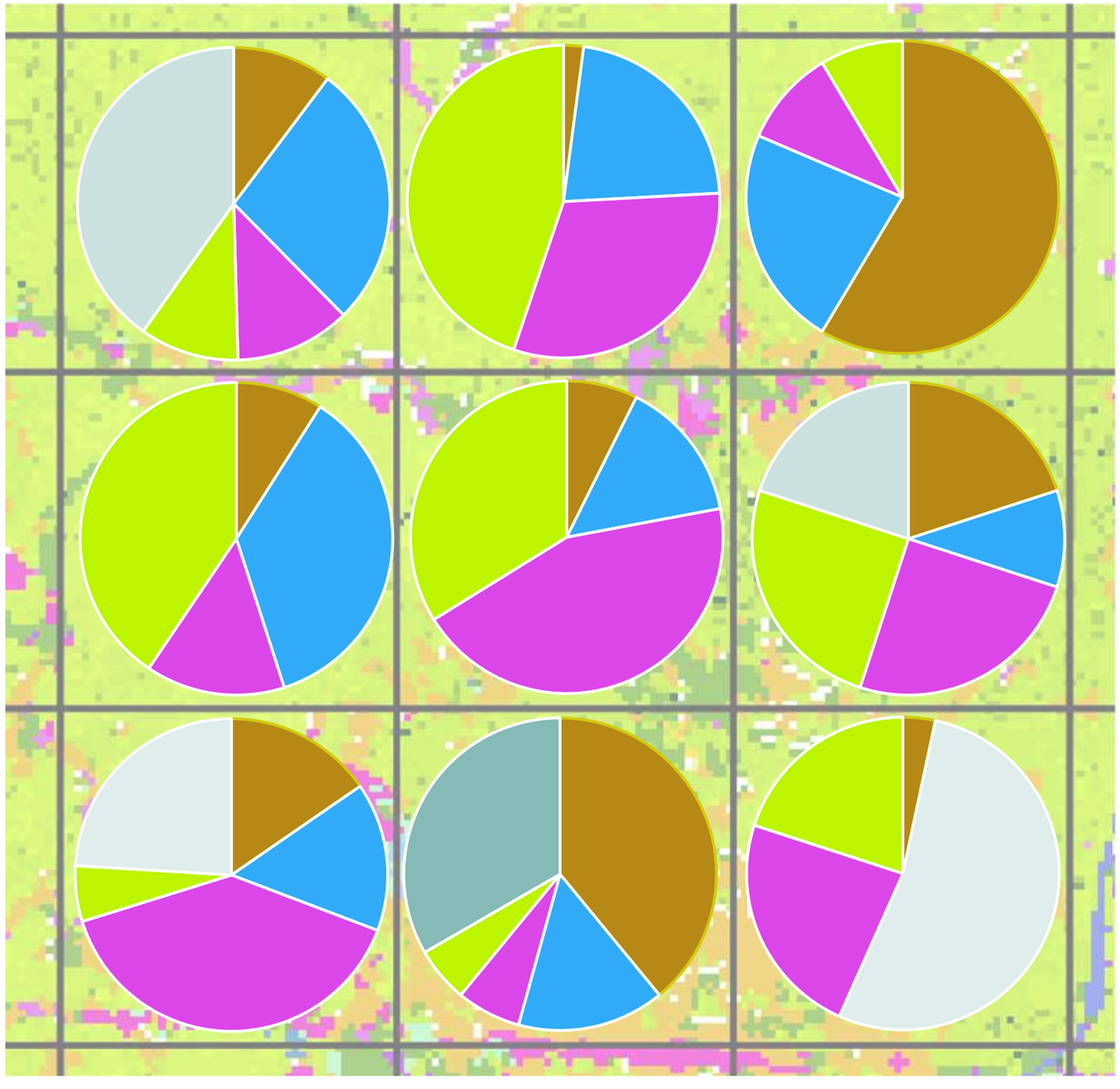
- The coverage of every species is summed in each ICM-LAVegMod grid box
- ICM-LAVegMod keeps track of coverage percentages
- ICM-Morph keeps track of where the vegetation is within each ICM-LAVegMod grid box



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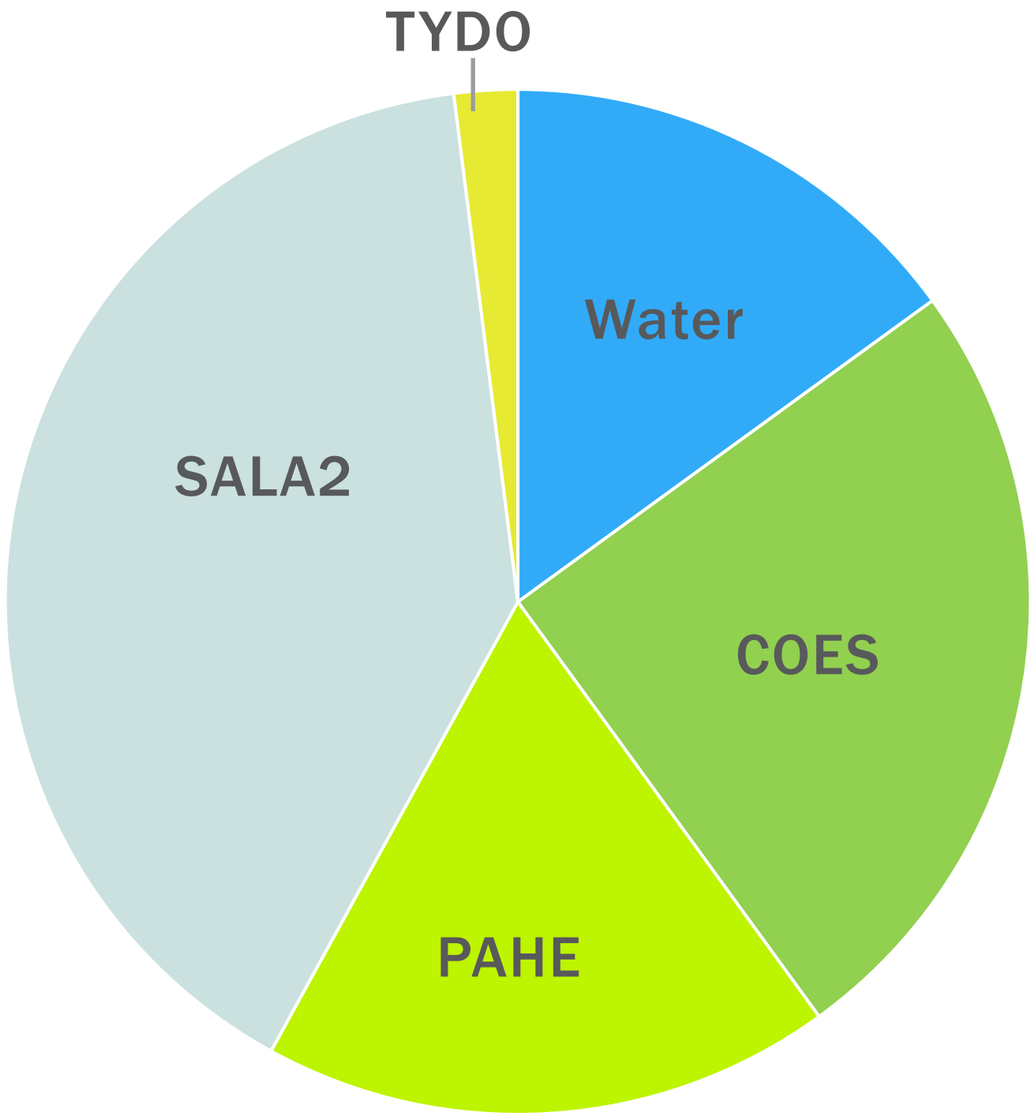
ICM-LAVEGMOD: PROCESSES

ONE YEAR OF MODEL PROCESSES FOR ONE GRID BOX



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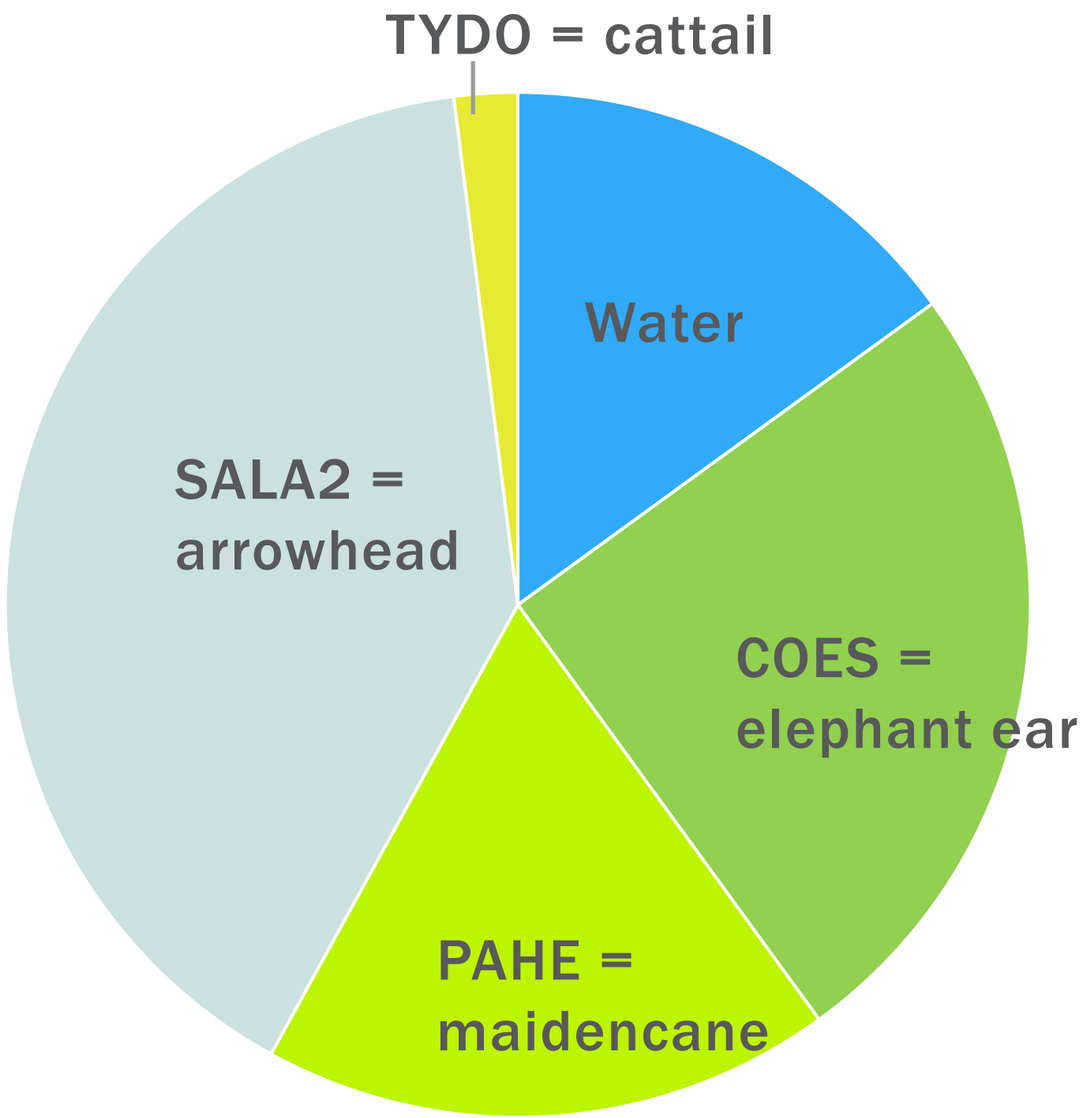

ICM-LAVEGMOD: PROCESSES

DETERMINE LAND CHANGES FROM ICM-MORPH

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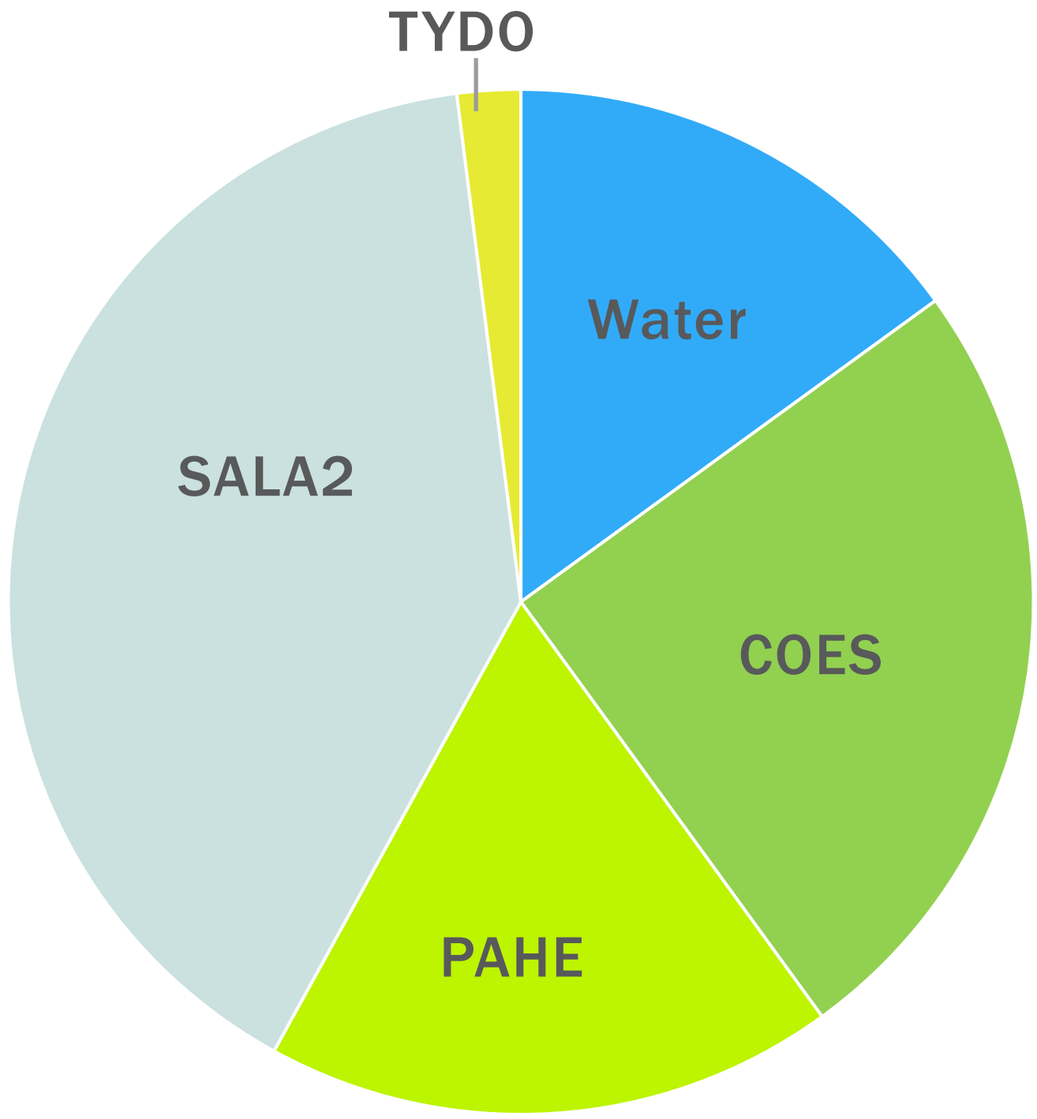
- Compare the %water from ICM-Morph to the current %water in the grid box



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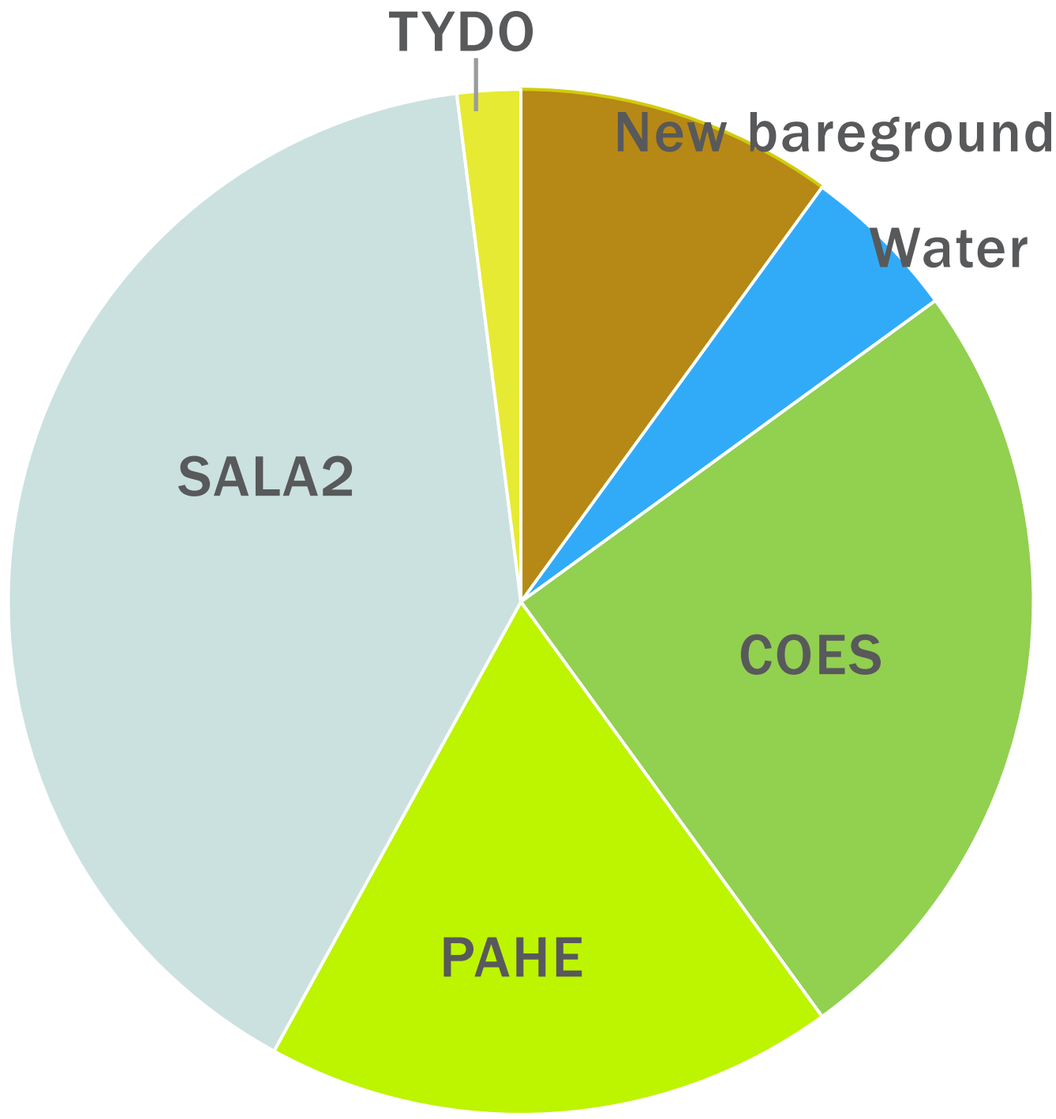
- Compare the %water from ICM-Morph to the current %water in the grid box
- For this example, land was gained: water coverage is reduced and new bareground is created



ICM-LAVEGMOD: PROCESSES

HIGH DISPERSAL SPECIES CAN ESTABLISH

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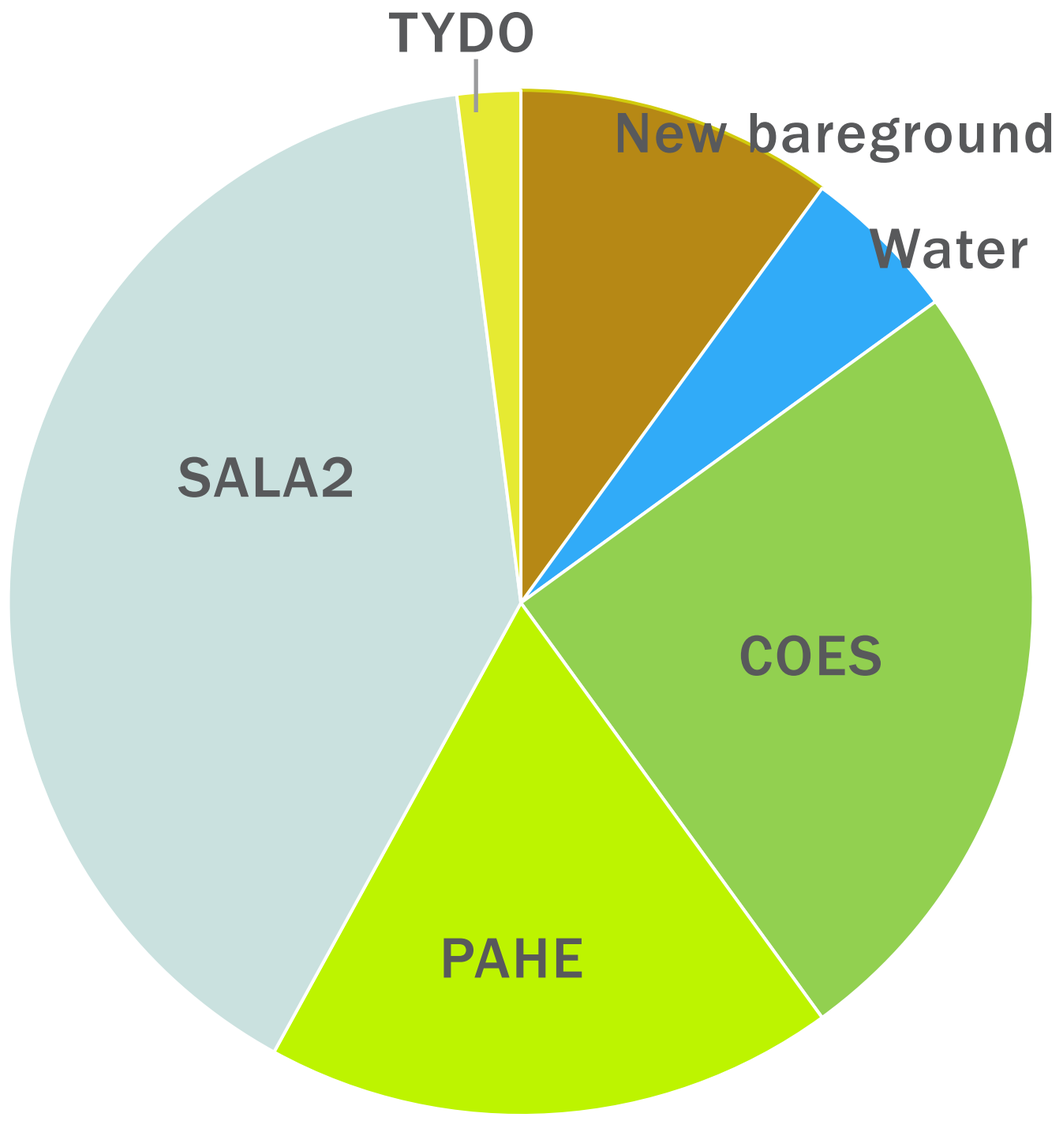
- The probability of **establishment** is determined by the annual salinity and the water level variability



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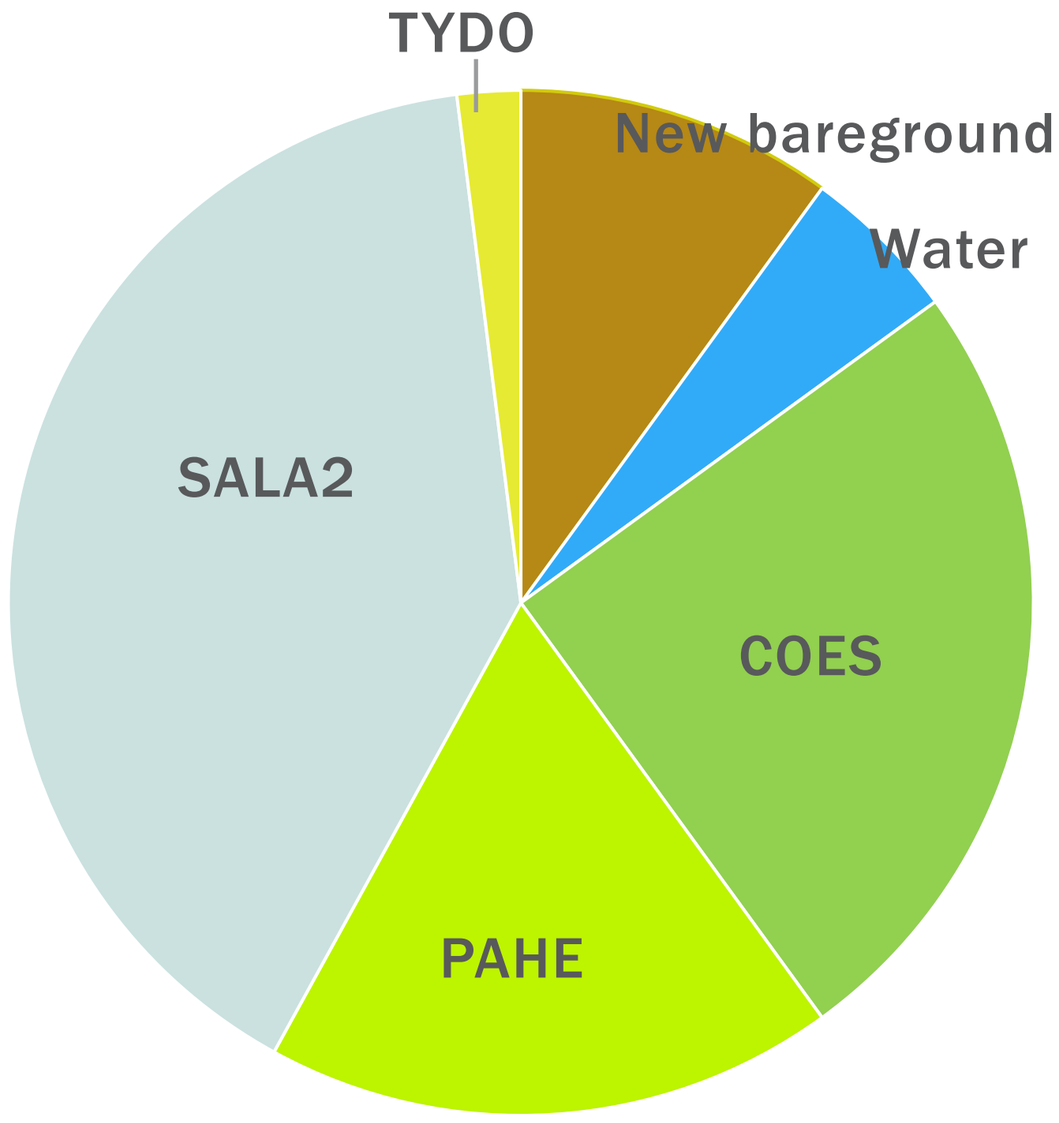
  - Annual salinity = 0.8 ppt
  - Water level variability = 0.12 m
  - Limited species selection for simplicity



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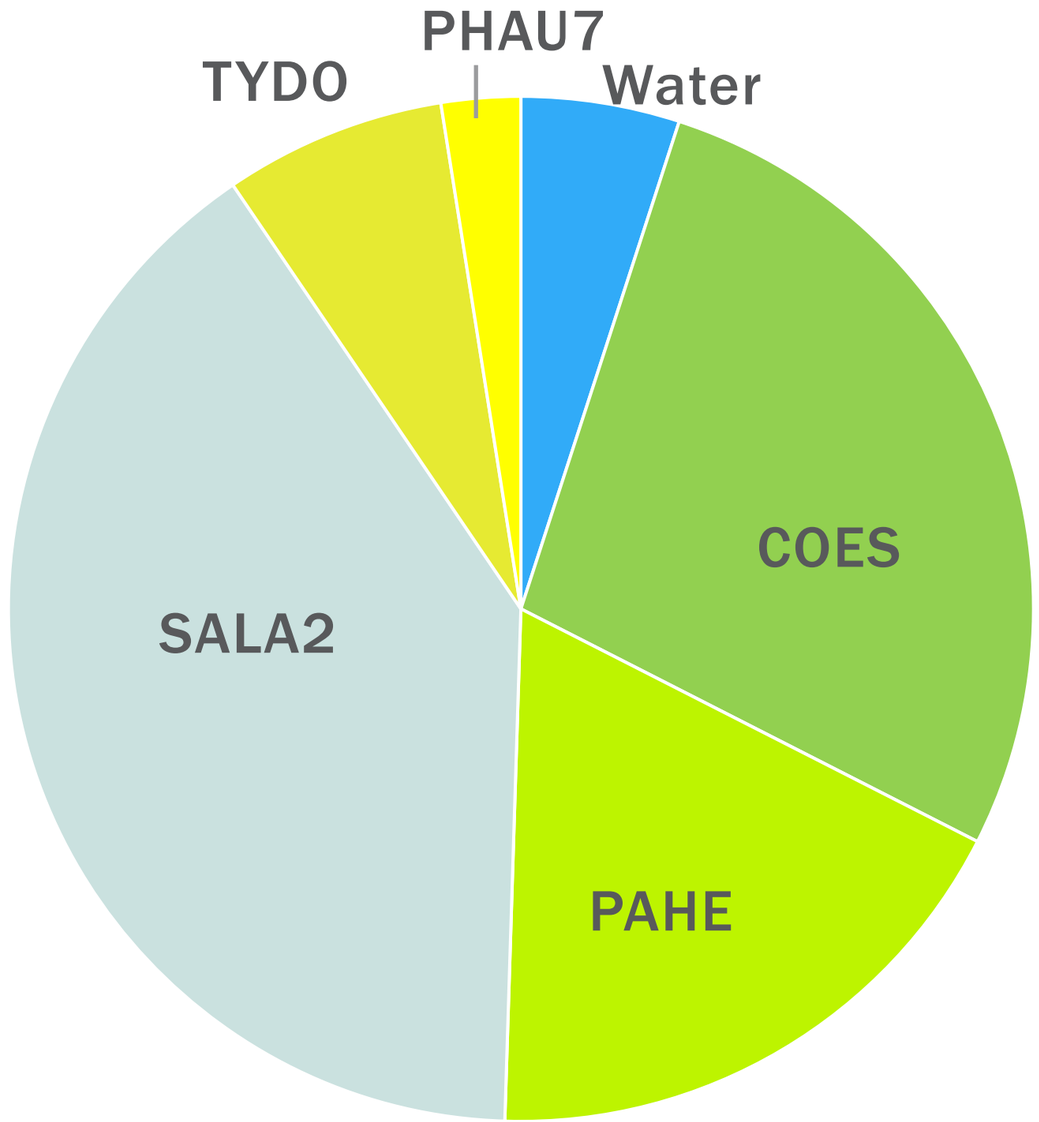

ICM-LAVEGMOD: PROCESSES

MORTALITY

- The probability of **mortality** is determined for every species by the annual salinity and the water level variability
- The probability of **mortality** is directly applied to reduce the coverage
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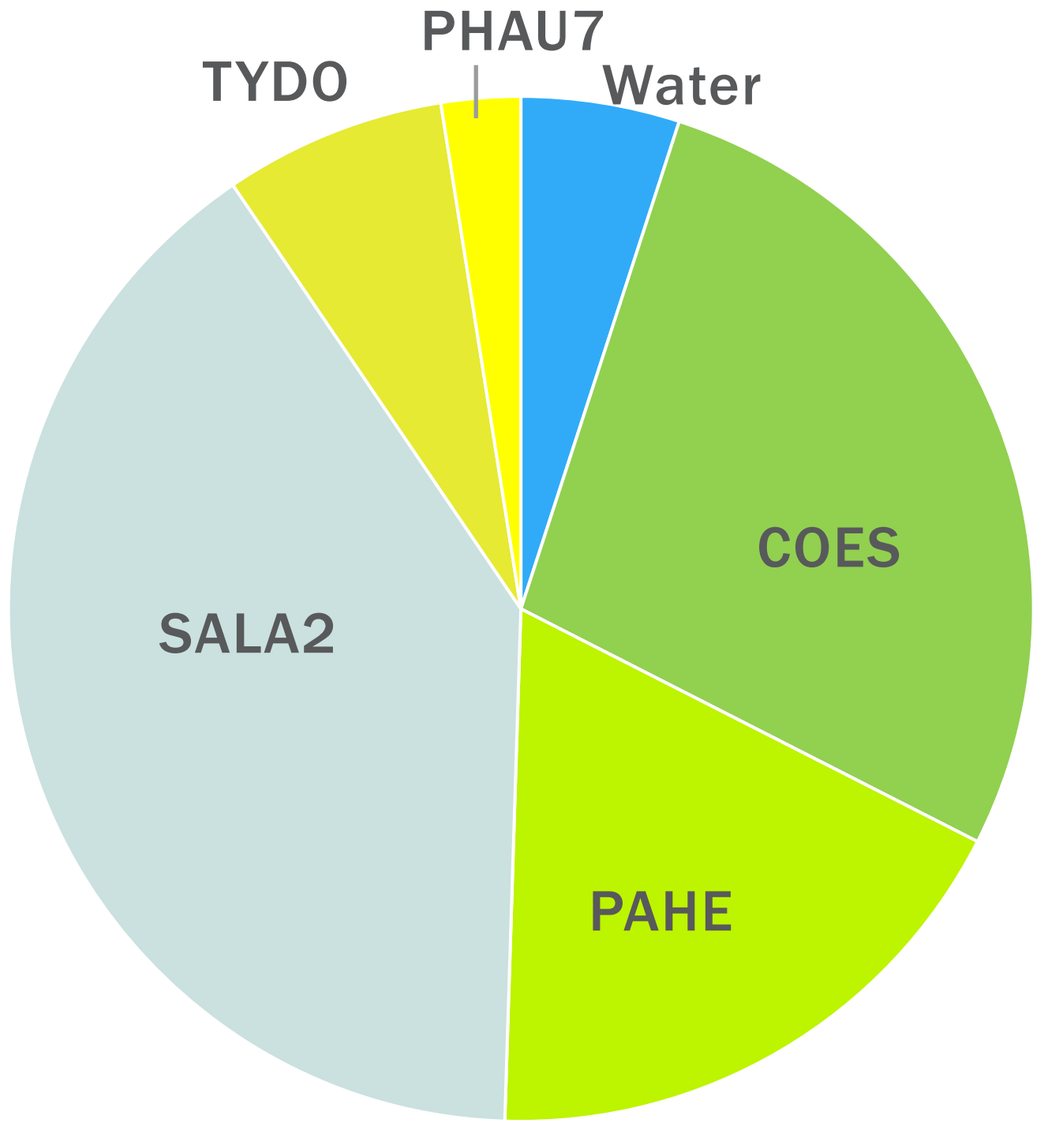

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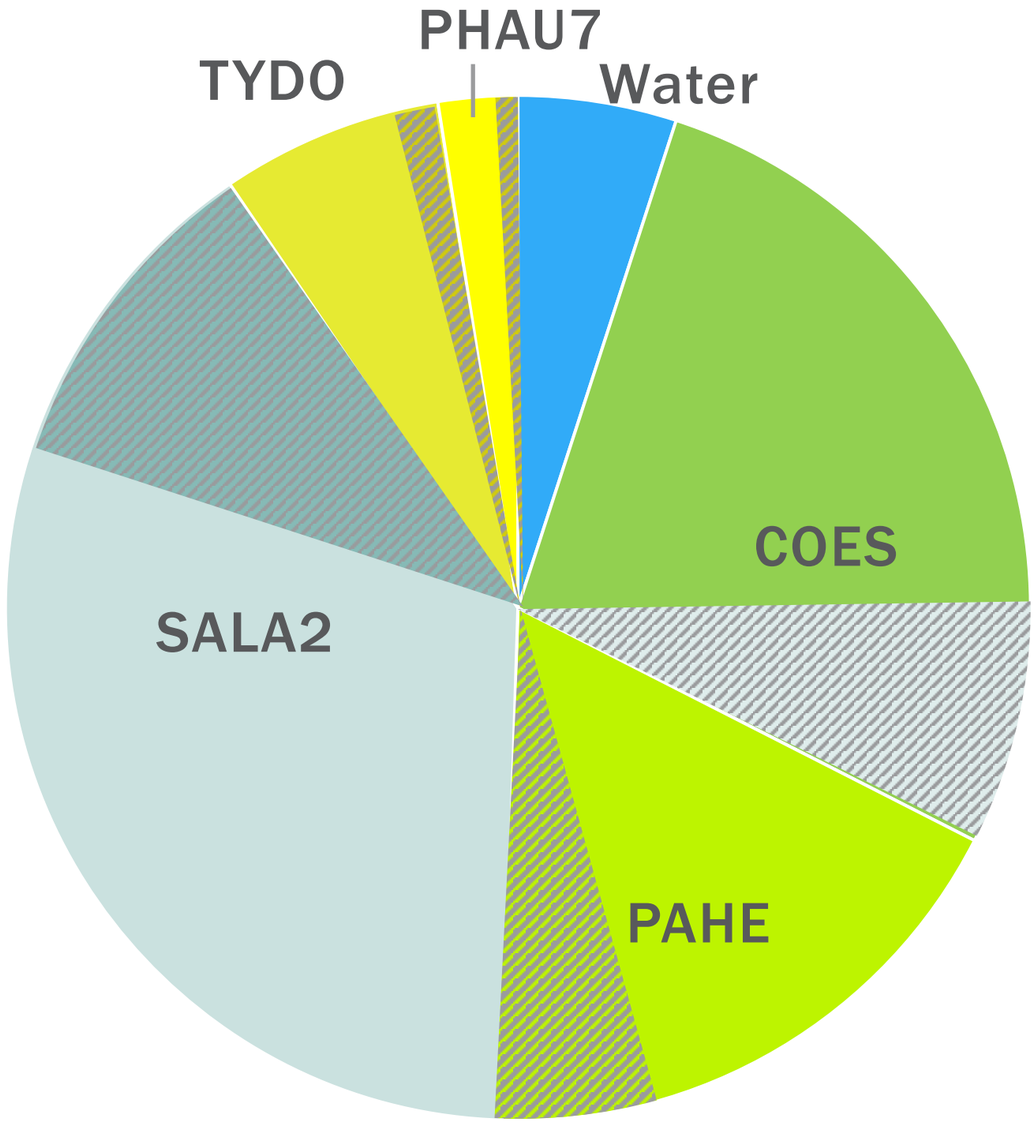

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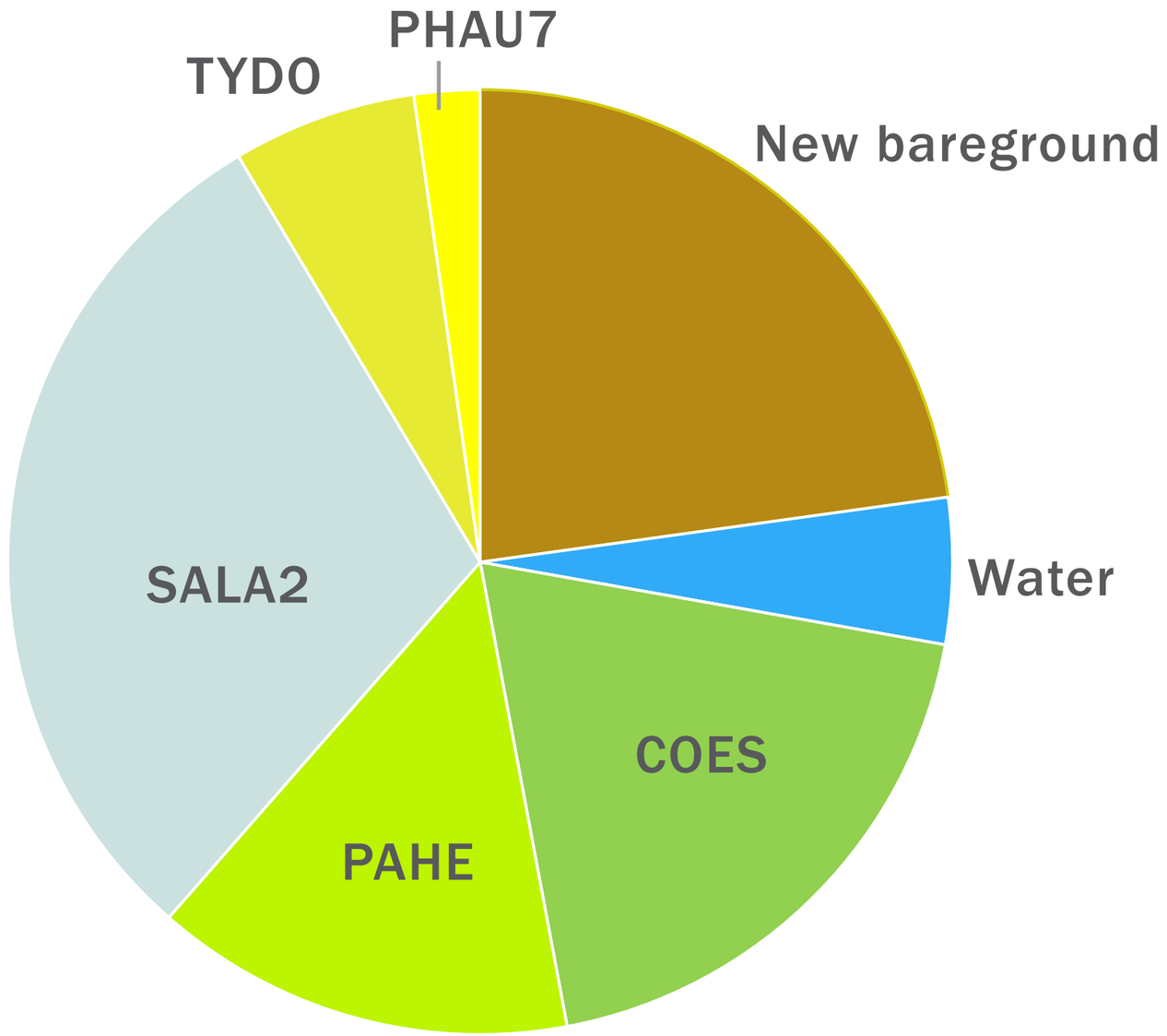
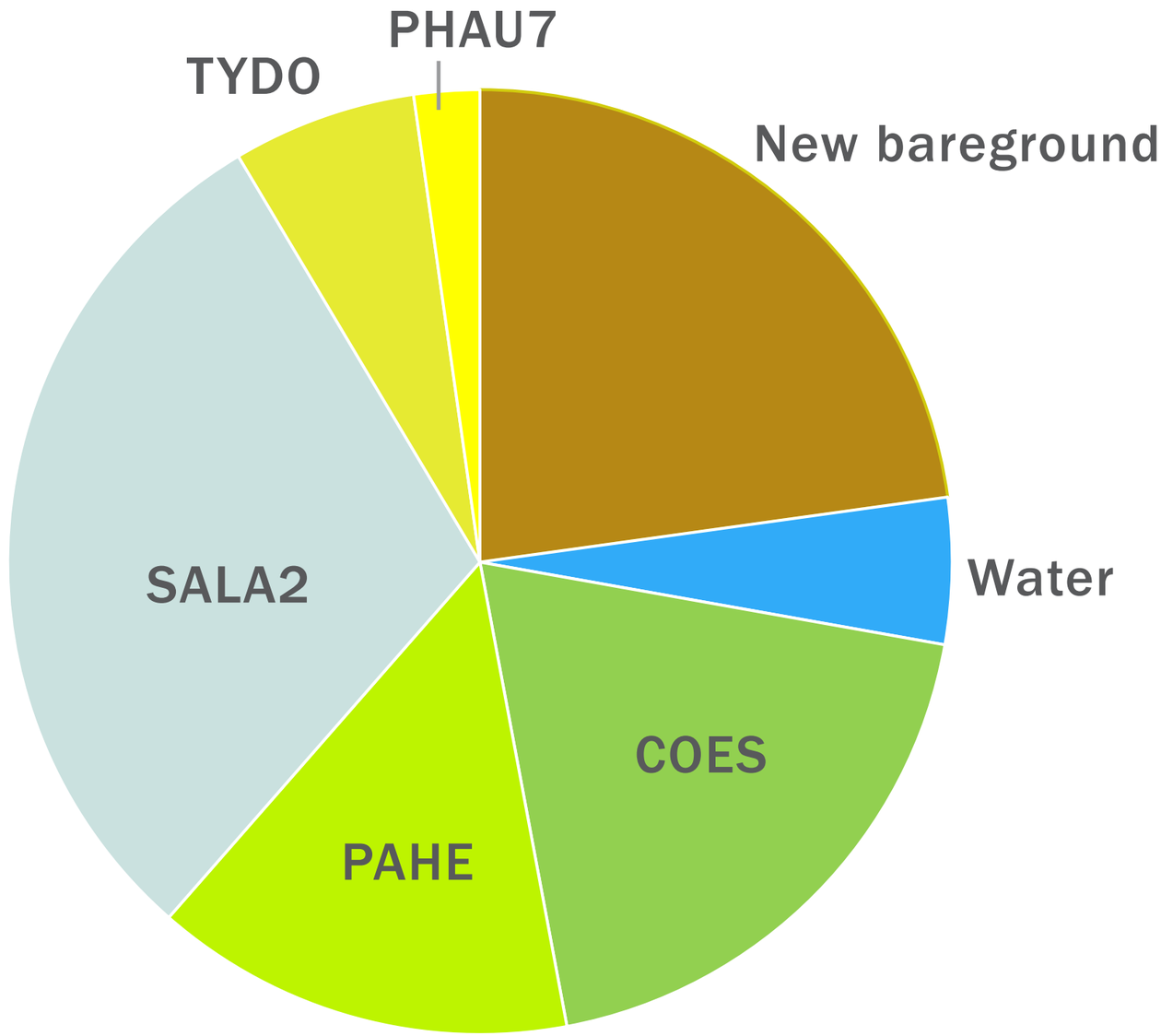


ICM-LAVEGMOD: PROCESSES

ESTABLISHMENT

- The probability of **establishment** is determined for every species by the annual salinity and the water level variability
- The probability of **establishment** is not directly applied.
- The available new bareground is distributed between the species based on:
  - Establishment probability
  - Presence in the surrounding grid boxes



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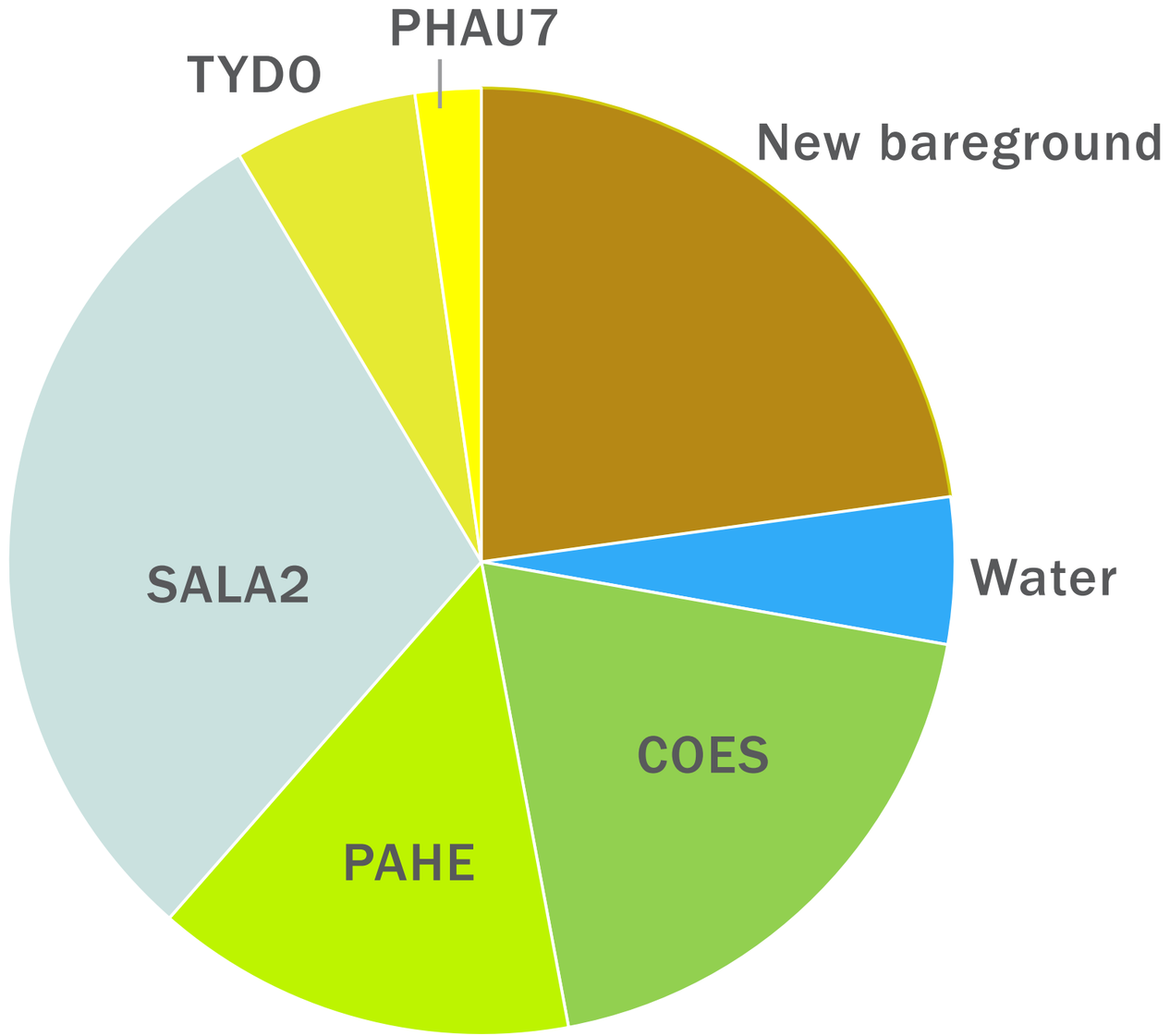

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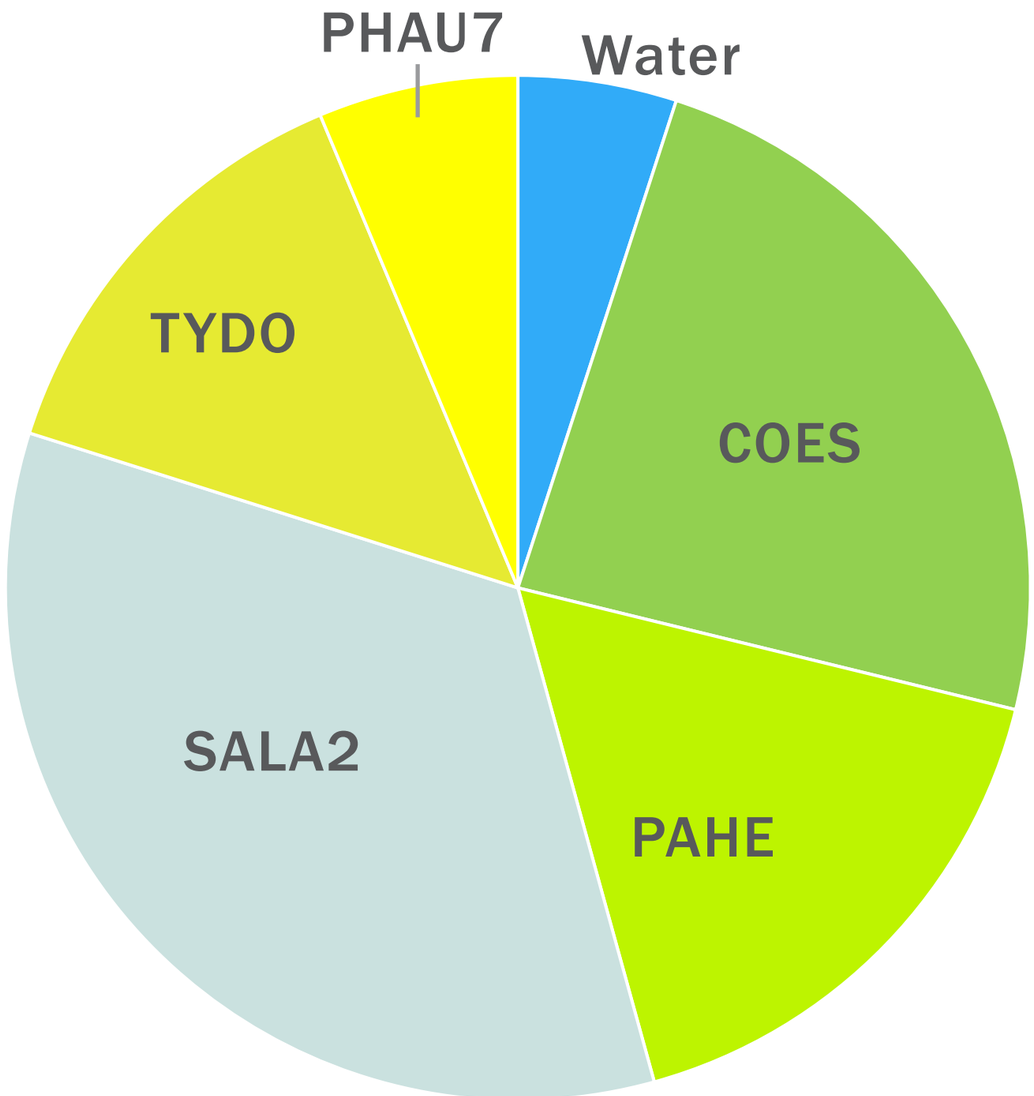
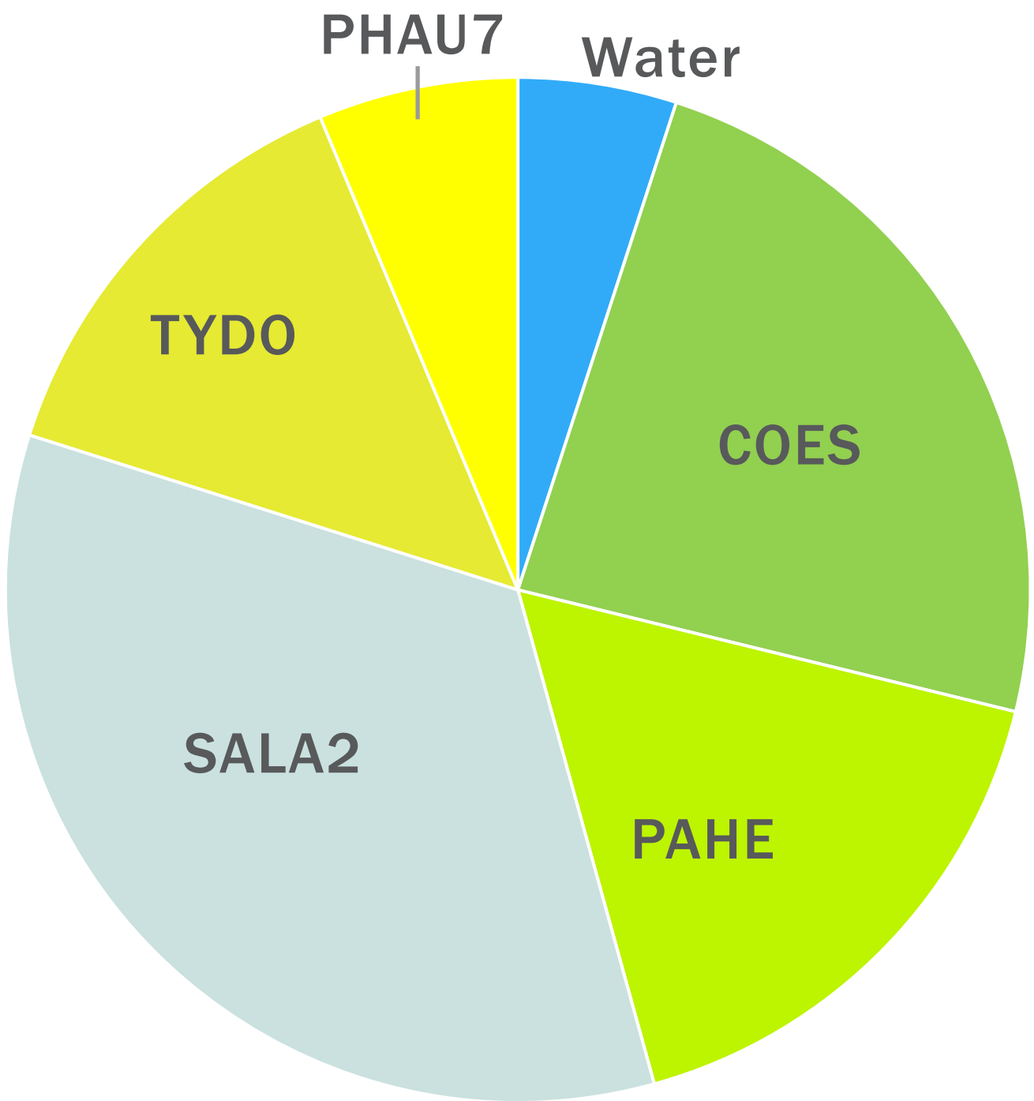


ICM-LAVEGMOD: PROCESSES

ACUTE SALINITY STRESS

- If the salinity was greater than 5.5 ppt for 2 weeks, then the freshwater marsh are removed completely from the grid box



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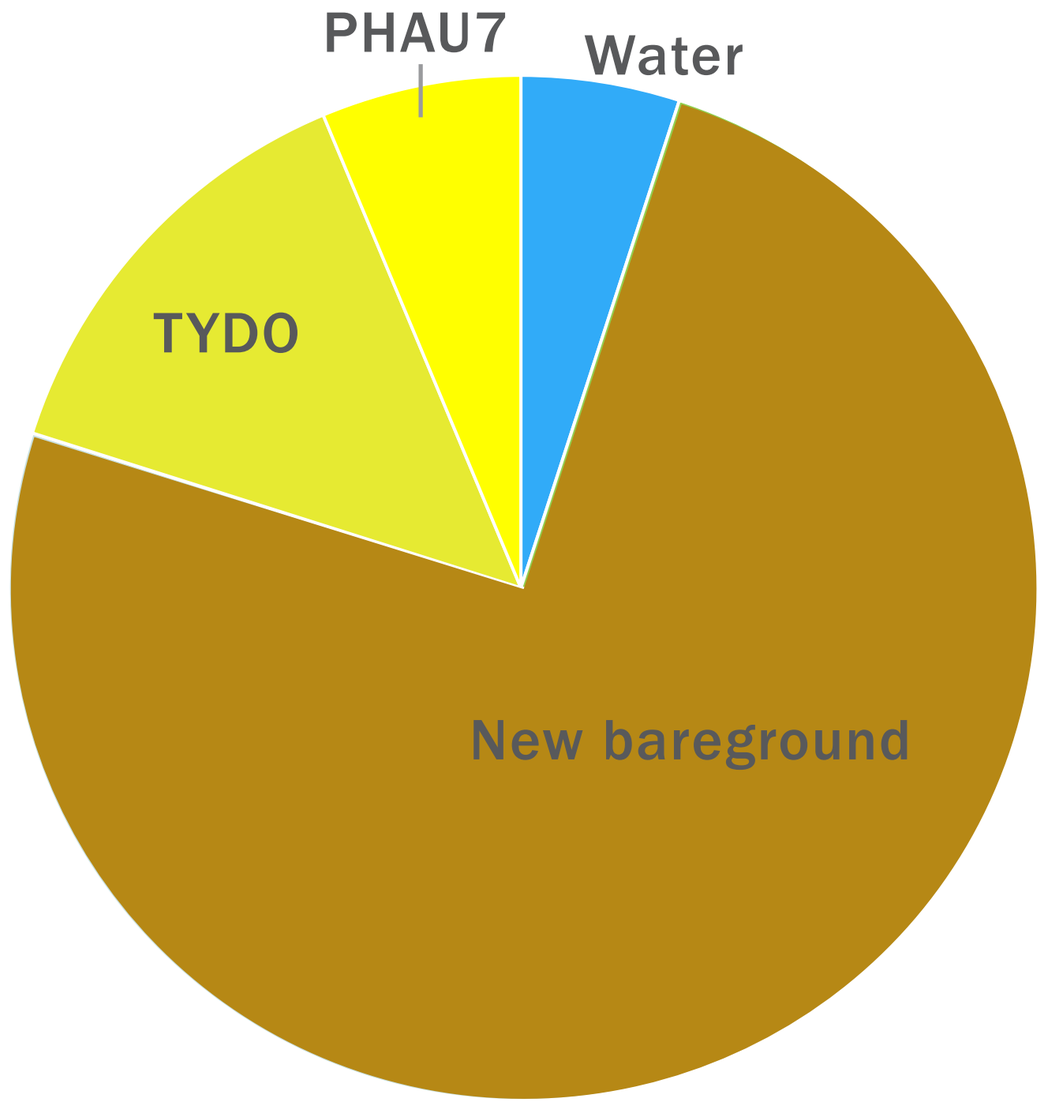

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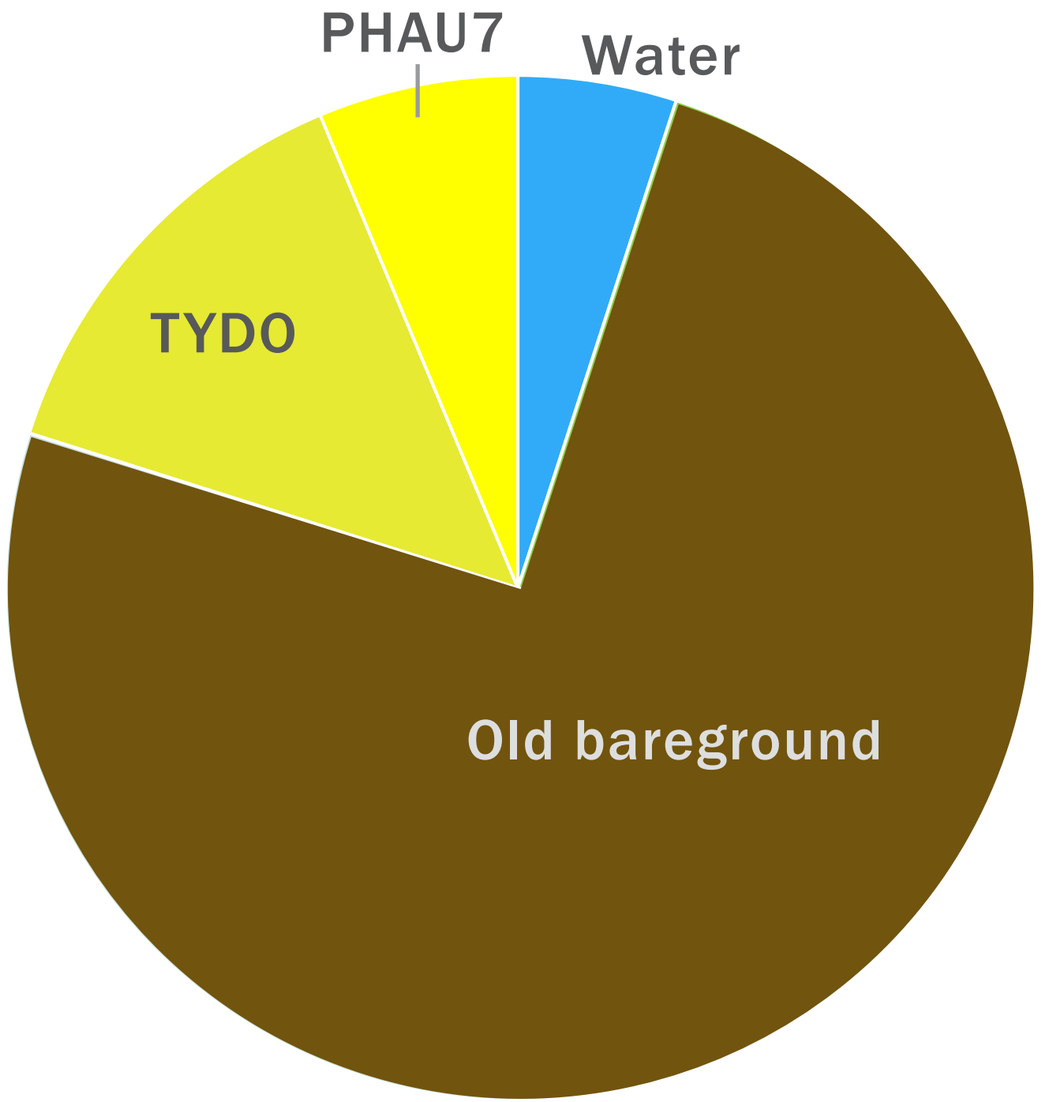
- If nothing is able to establish on new bareground, the next year it becomes old bareground

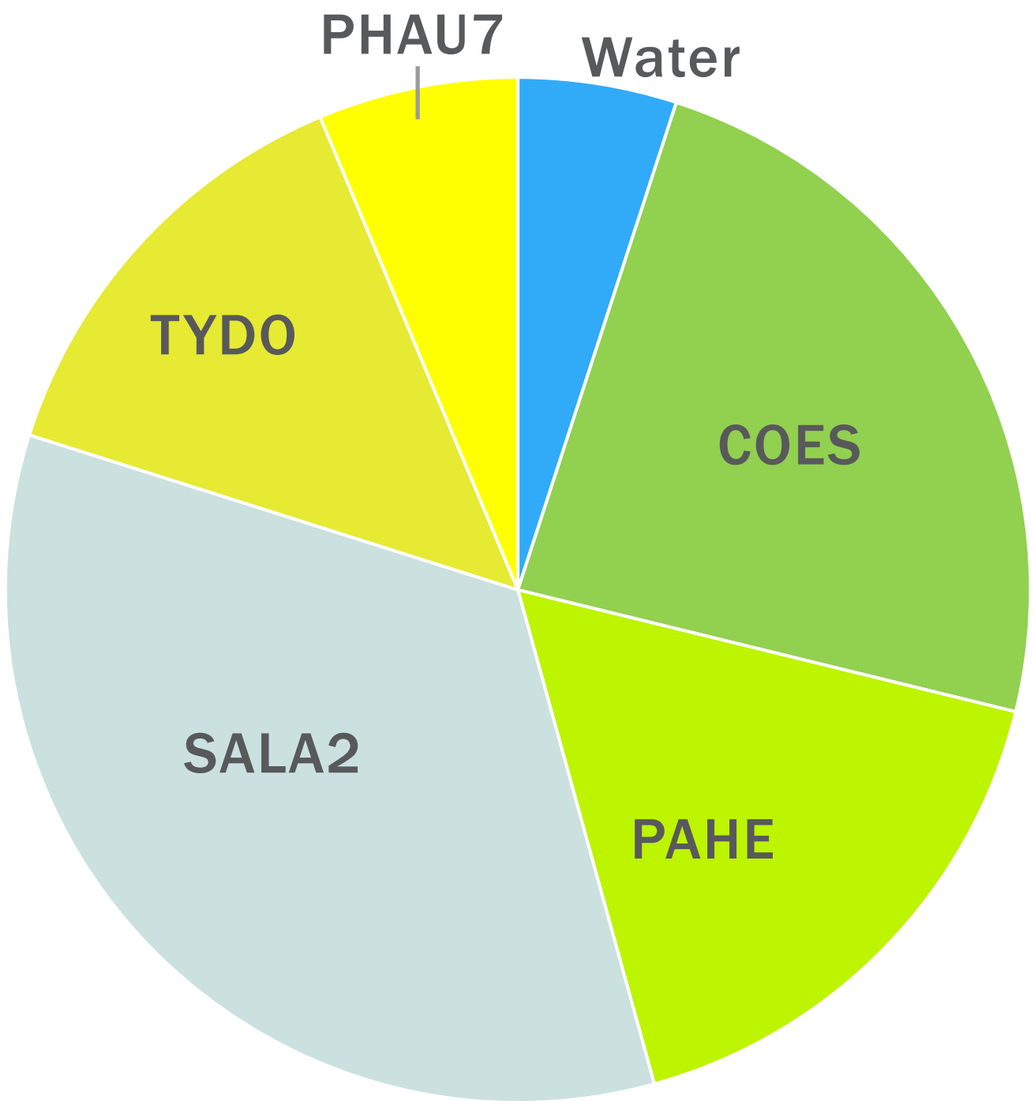


ICM-LAVEGMOD: PROCESSES

FFIBS SCORE

- The FFIBS score is an average of the FFIBS values weighted by the area occupied by each species
- For this example:
  - PHAU7 = 2.75
  - TYDO = 2.75
  - SALA2 = 0.25
  - PAHE2 = 0.25
  - COES = 0.25

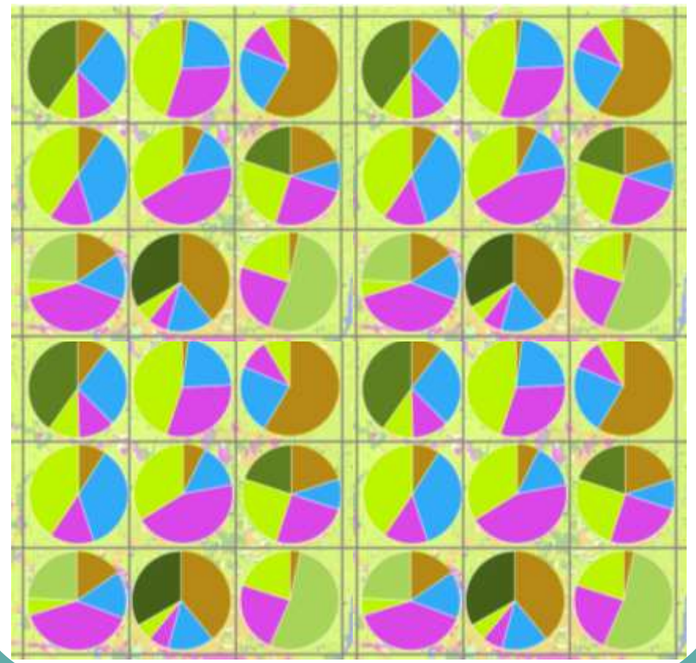
FFIBS score → 0.8



ICM-LAVEGMOD TO ICM-MORPH

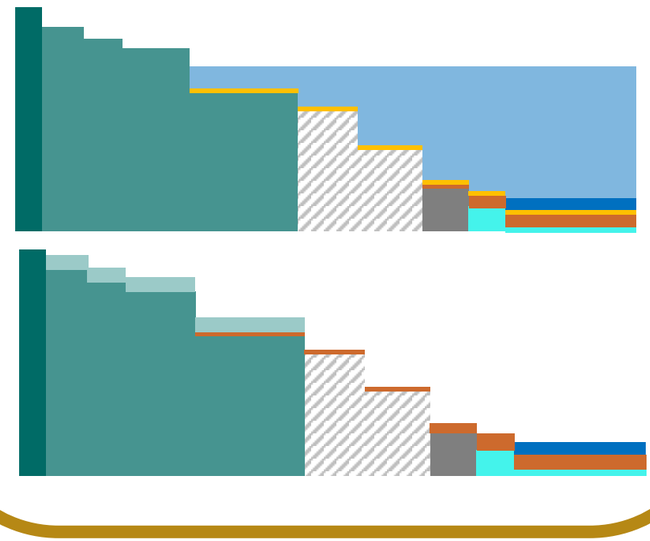
PASS INFORMATION

ICM-LAVegMod



- FFIBS score
- New bareground coverage
- Old bareground coverage
- Flotant loss

ICM-Morph



ICM-MORPH PROCESSES

SIDE VIEW OF ICM-MORPH GRID

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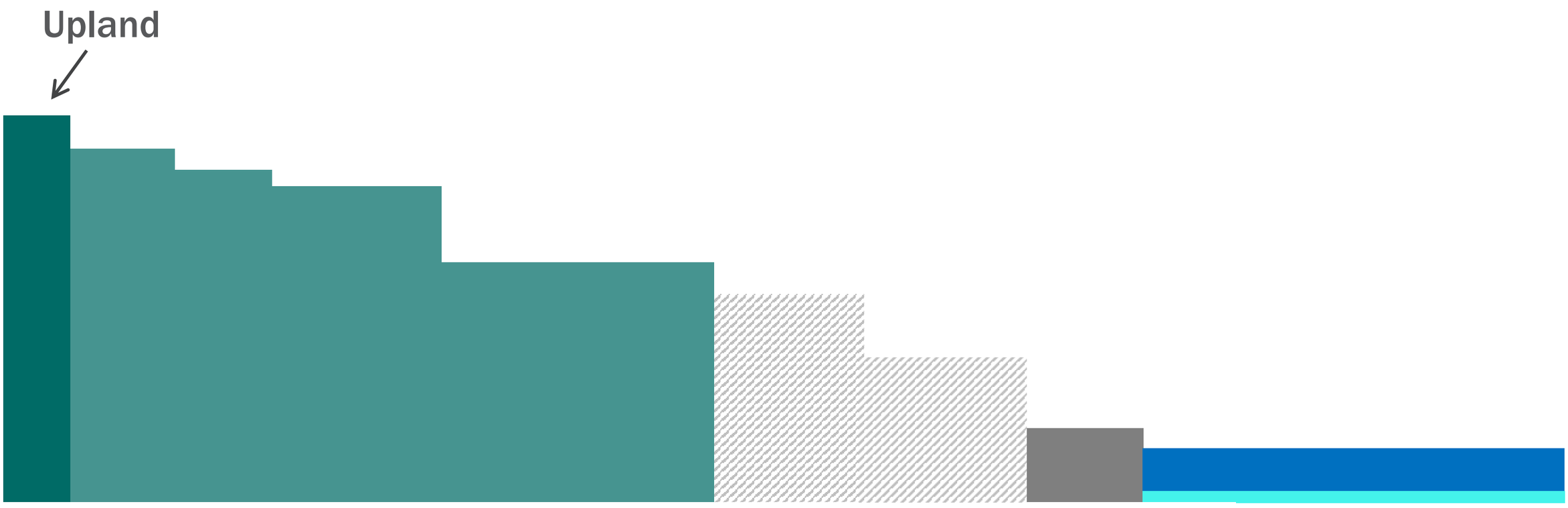

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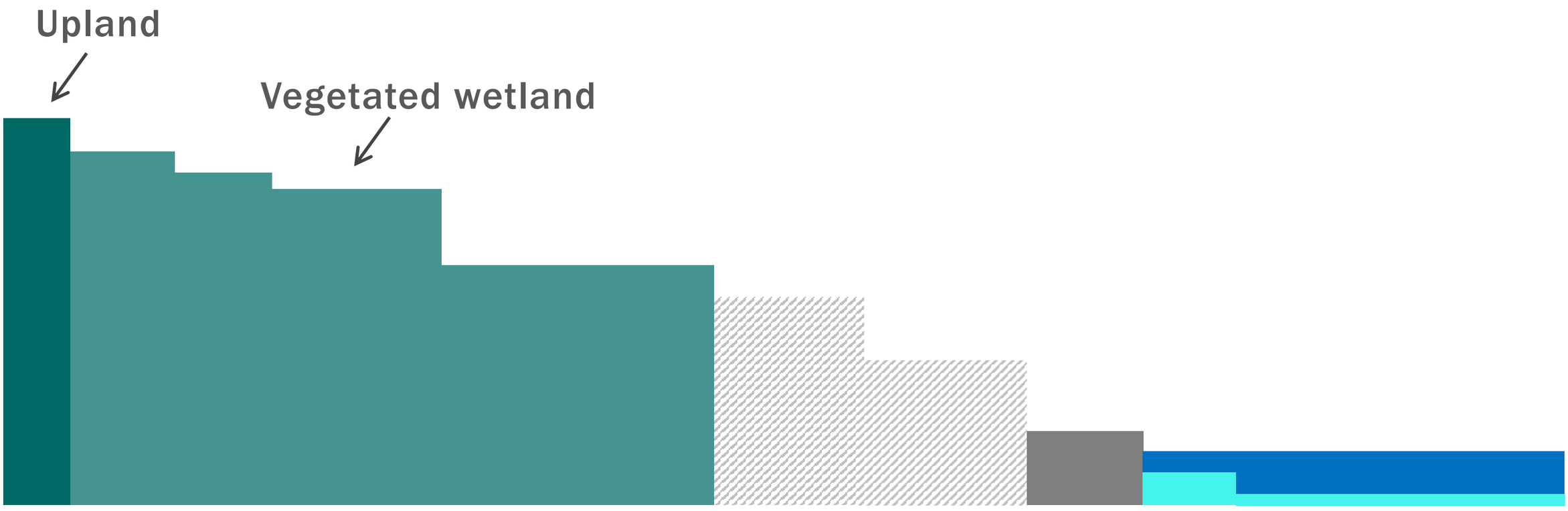

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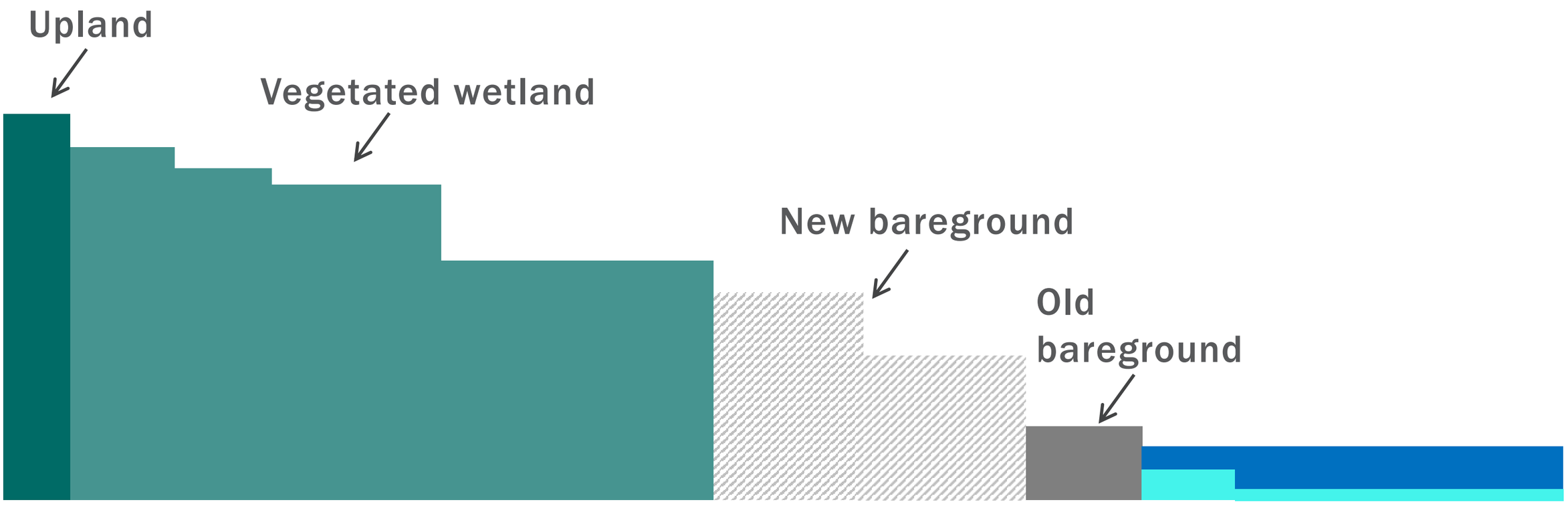
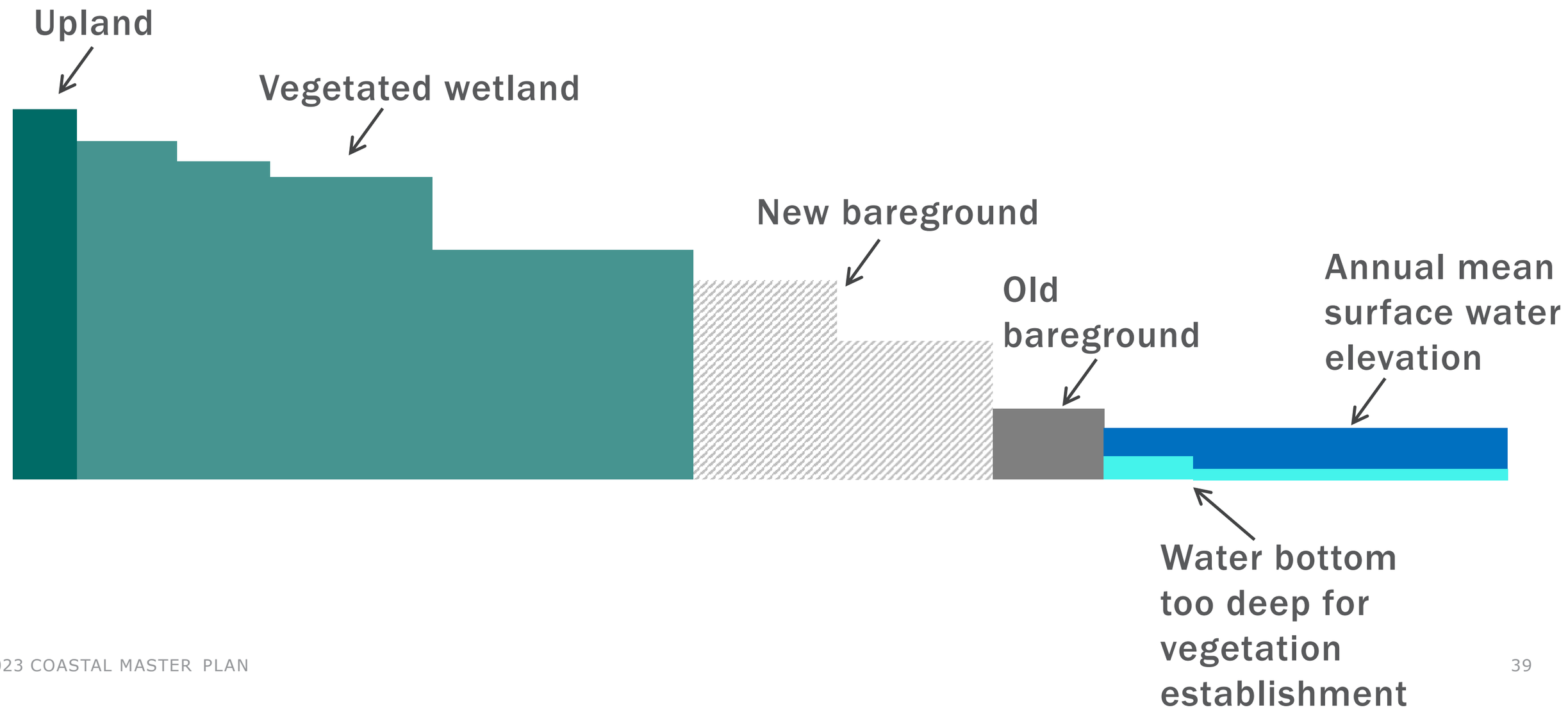


ICM-MORPH PROCESSES

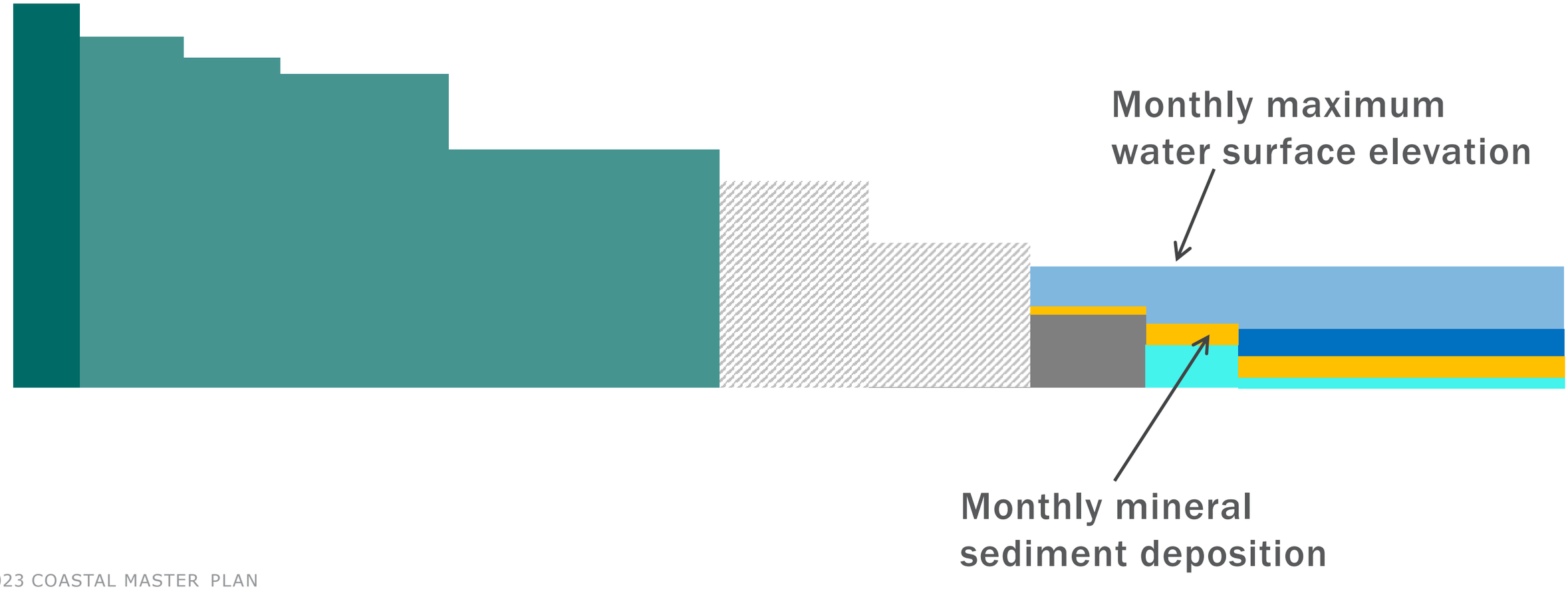
SIDE VIEW OF ICM-MORPH GRID



ICM-MORPH PROCESSES

MINERAL SEDIMENT DEPOSITION

- Amount of mineral sediment deposition is determined by the maximum water surface elevation
- Evaluated monthly



ICM-MORPH PROCESSES

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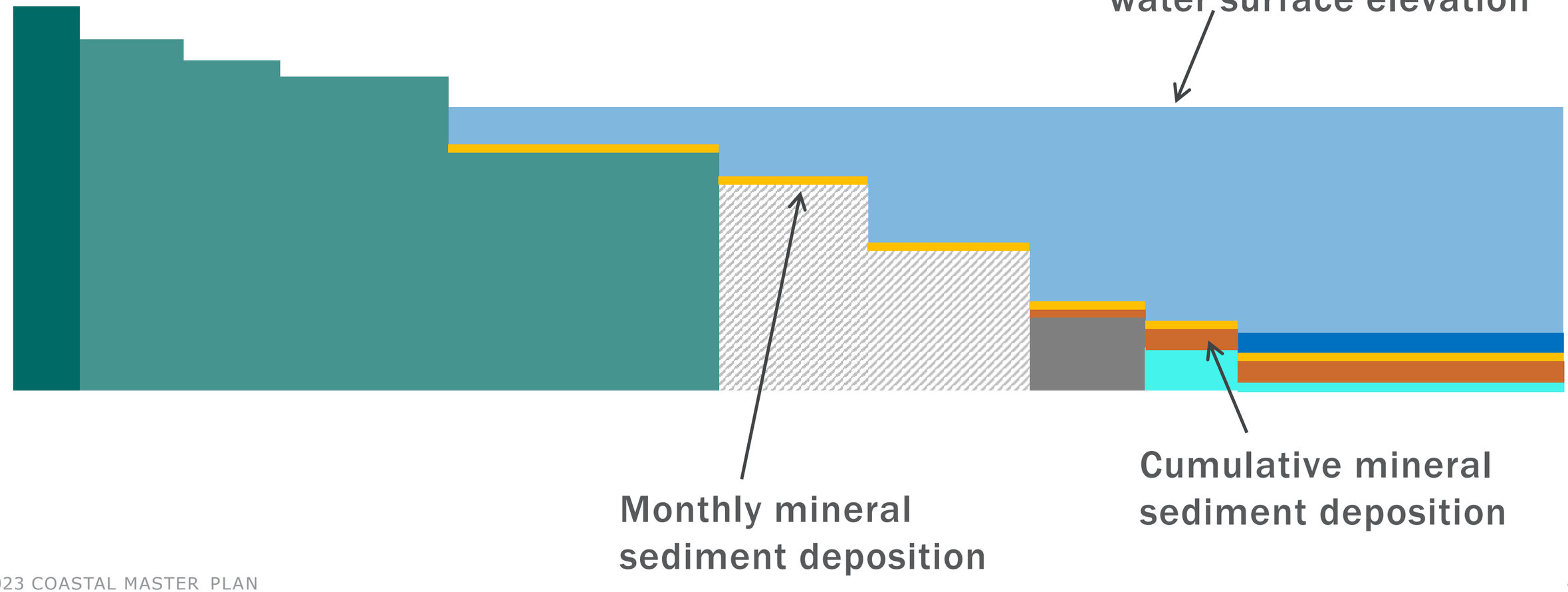
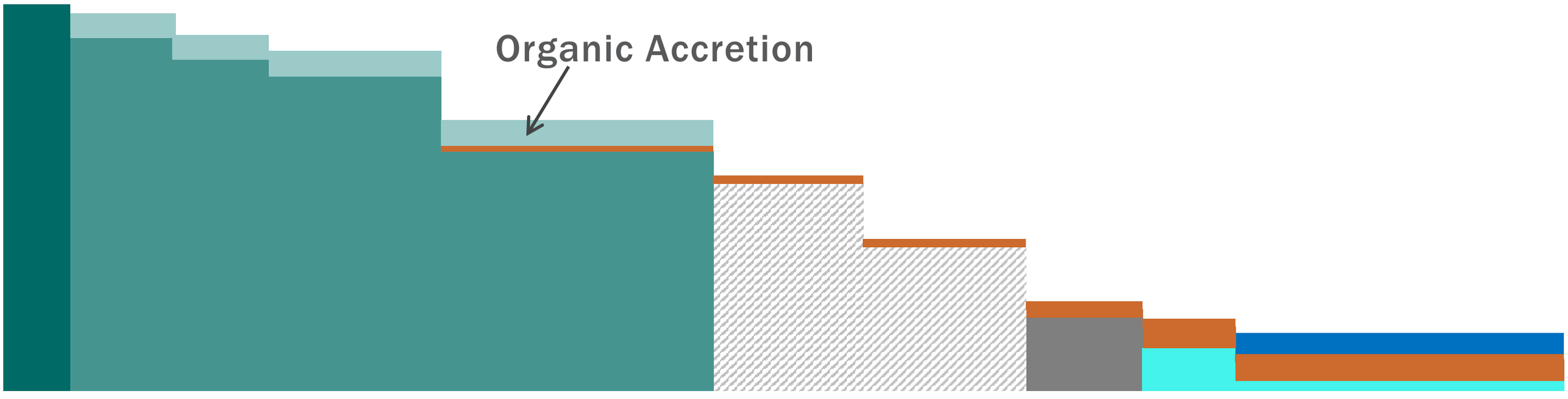


ICM-MORPH PROCESSES

ORGANIC ACCRETION

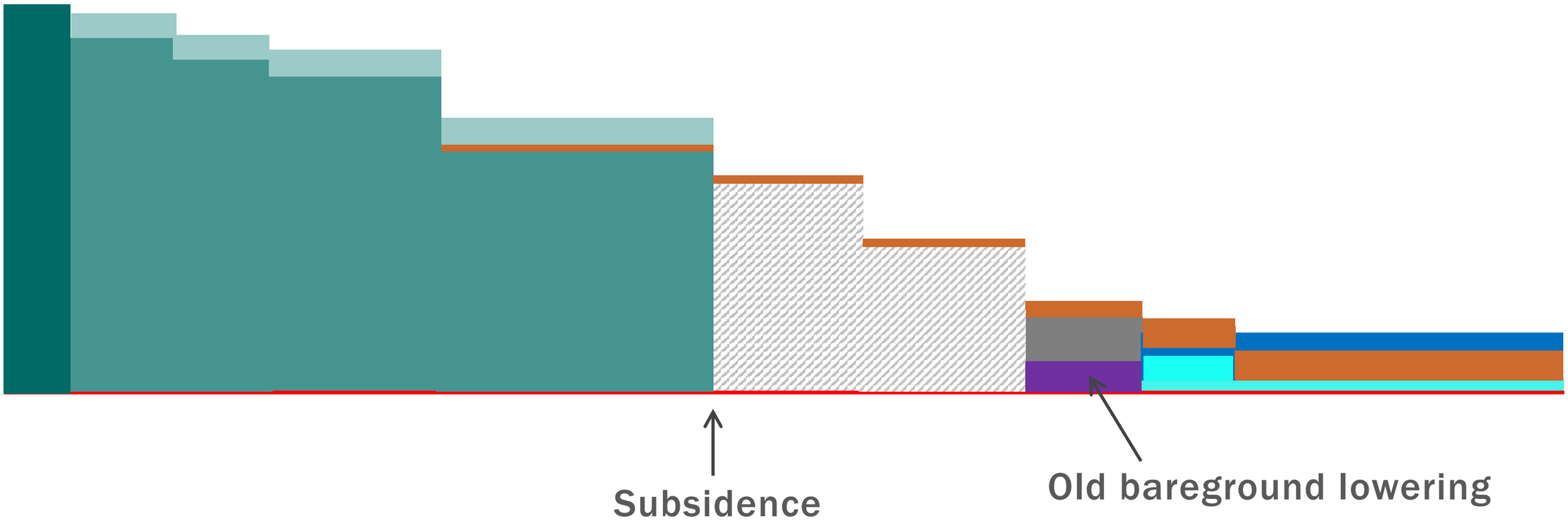
- Amount of organic accretion is determined by the habitat type (weighted FFIBS score)
- Evaluated annually



ICM-MORPH PROCESSES

ELEVATION LOSS

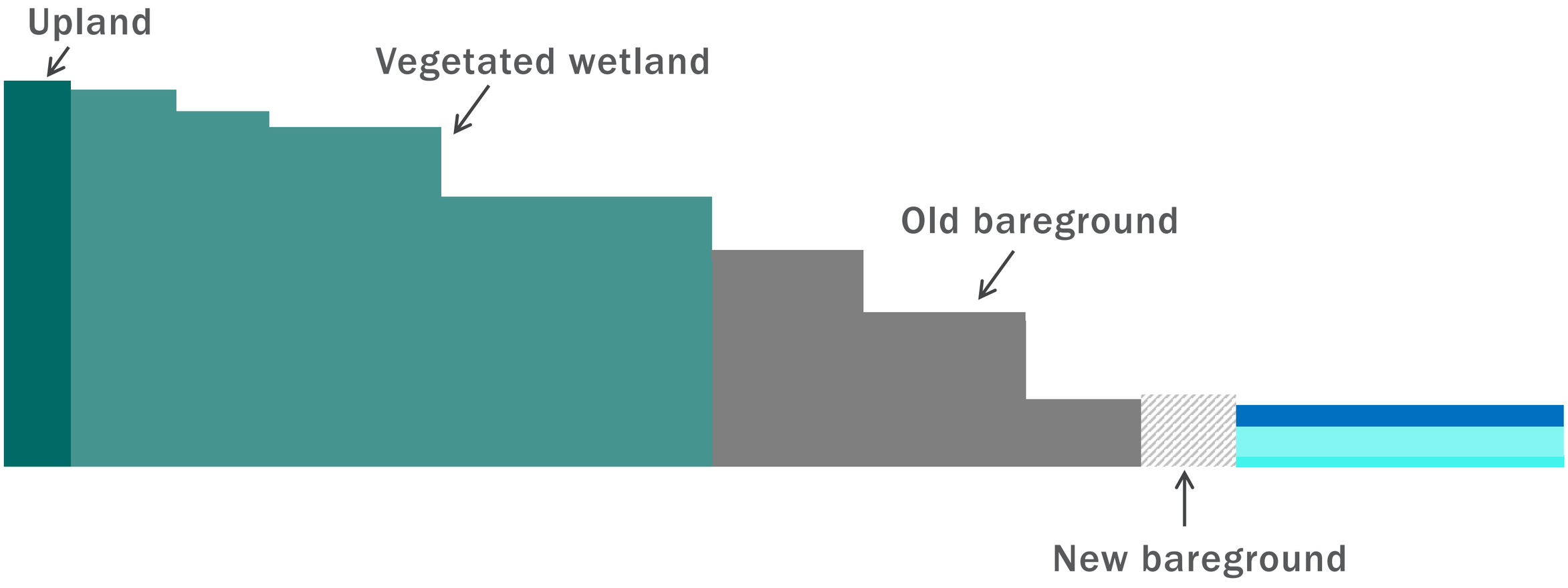
- Deep and shallow subsidence is spatially variable
- Old bareground is lowered (compaction)
- Evaluated annually



ICM-MORPH PROCESSES

OUTPUTS

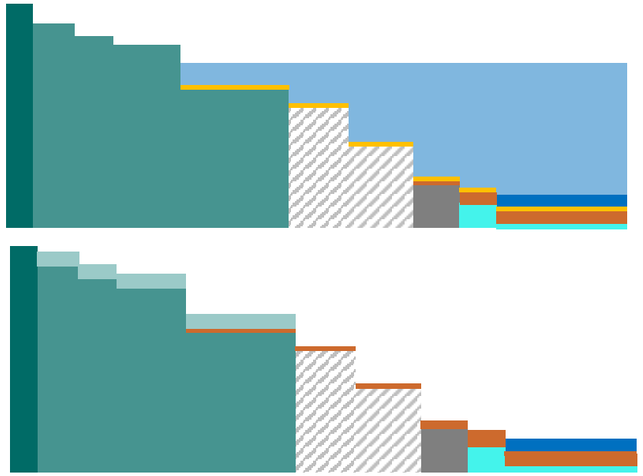
- Elevations are updated and evaluated to determine land/water
- Depth threshold between land/water varies with salinity



ICM-MORPH TO ICM-LAVEGMOD

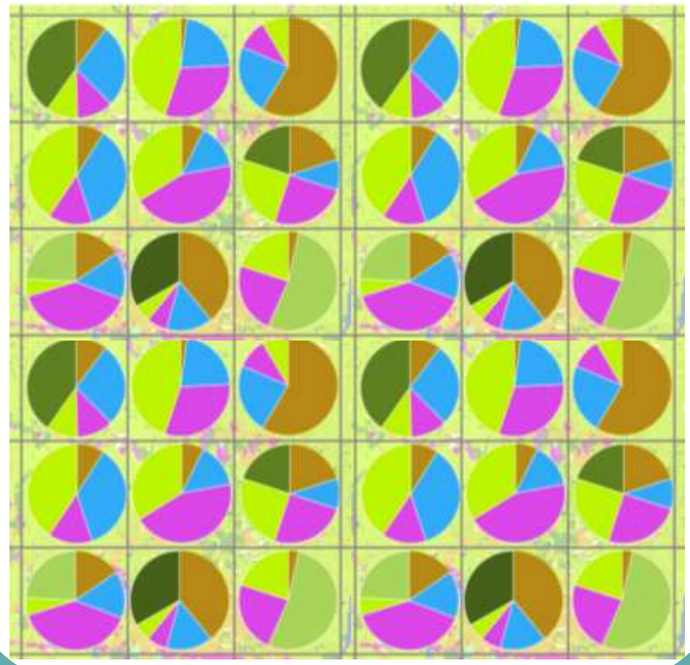
PASS INFORMATION

ICM-Morph



- Land and water coverages

ICM-LAVegMod



ICM-MORPH TO ICM-LAVEGMOD

PASS INFORMATION

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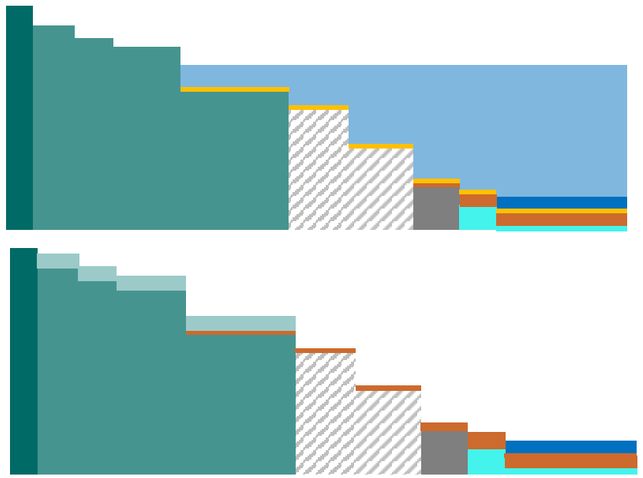
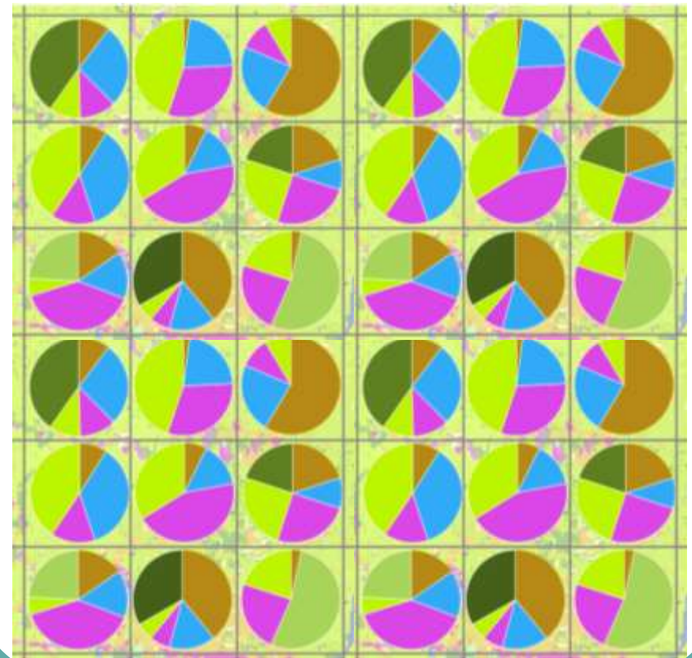


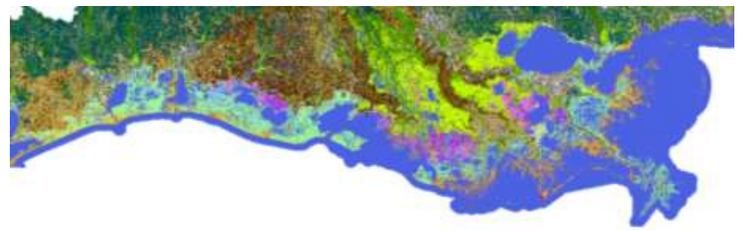
- Land and water coverages

- Elevation

ICM-LAVegMod

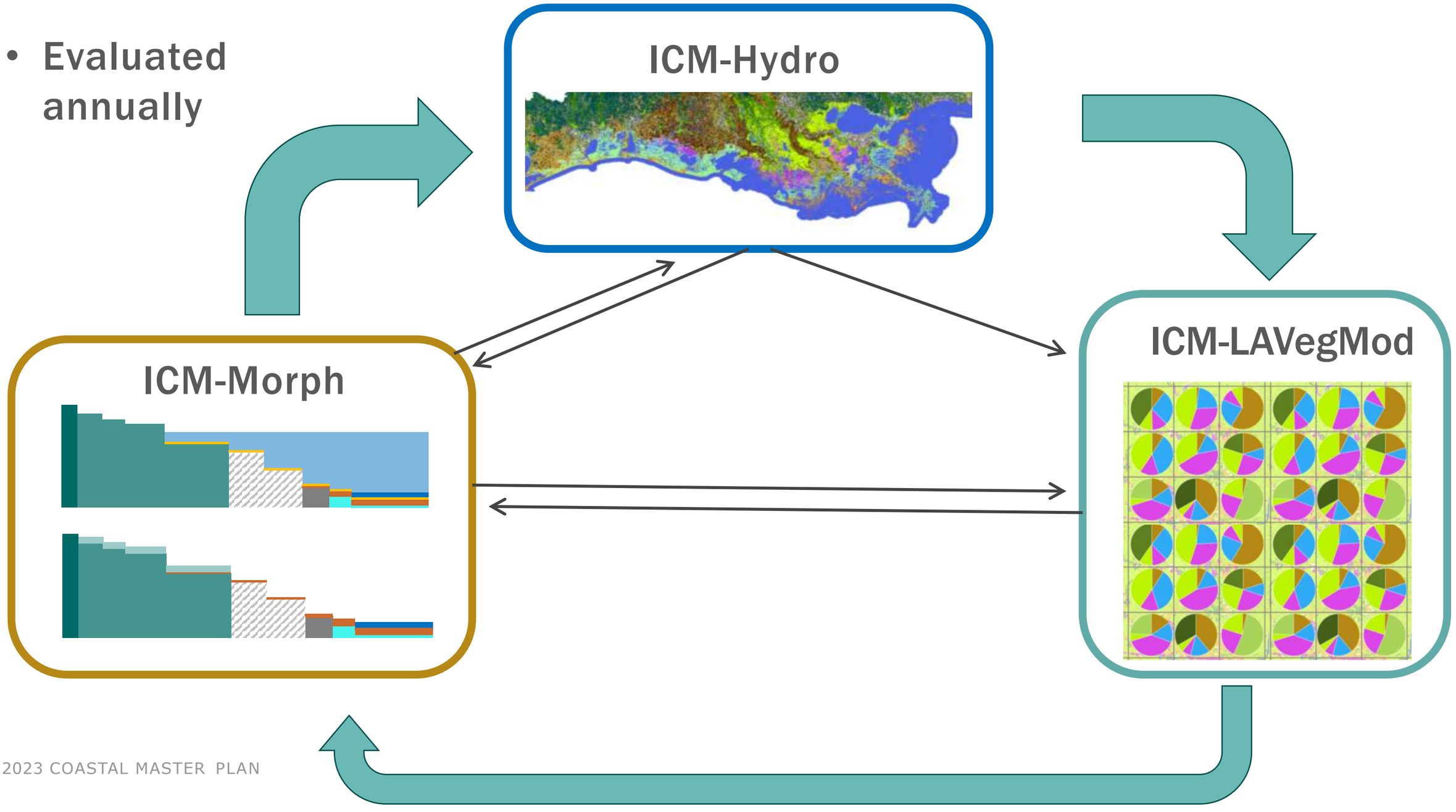


ICM-Hydro



ICM PROCESSES

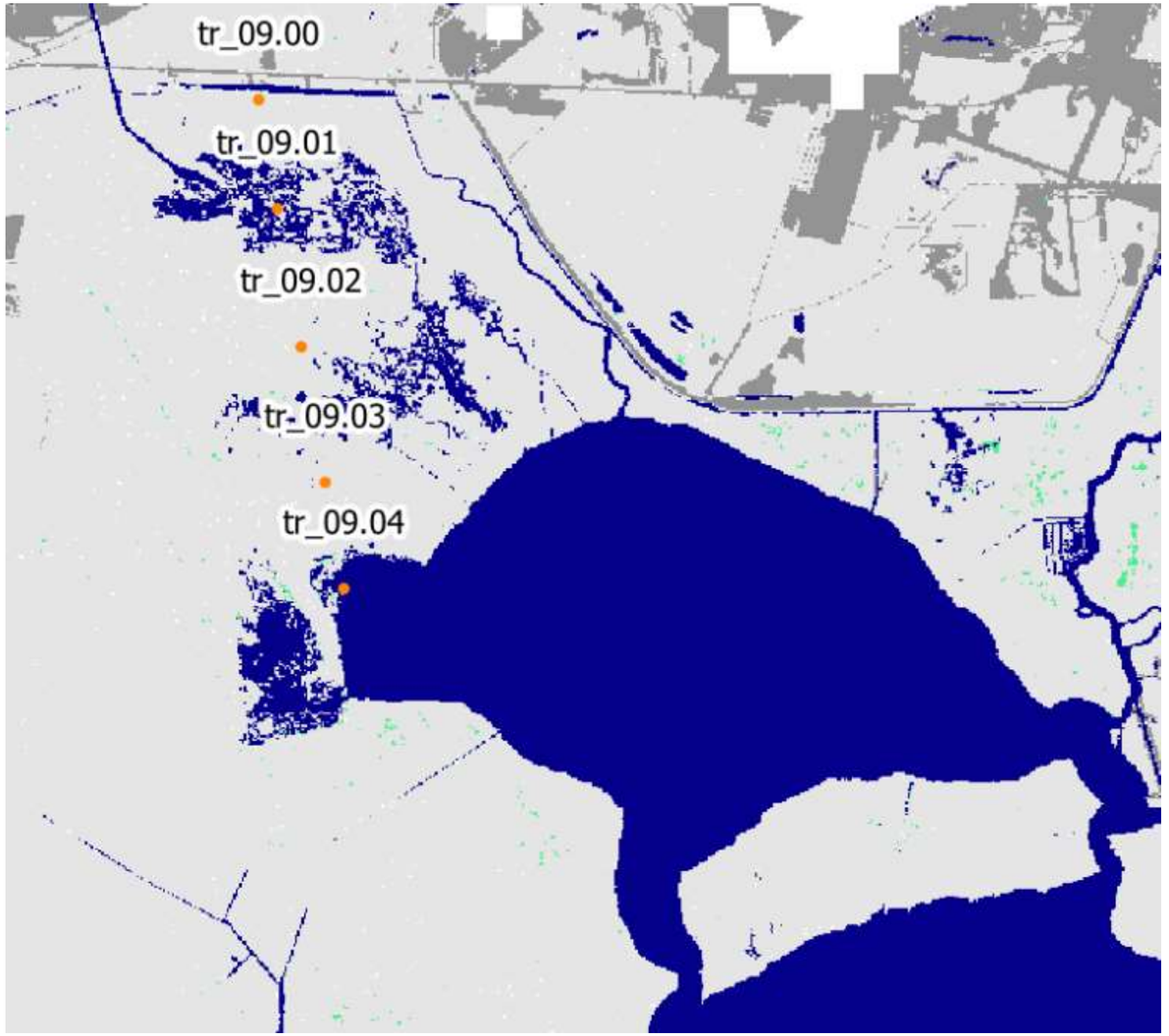
- Evaluated annually



ICM QA/QC

- Model output is examined across the coast
  - 365 CRMS stations
  - 250 spread throughout the ecoregions
  - 15 transects (76 sites total)

→ 691 sites



Example transect of observation sites north of Lake Cataouatche.

MORE INFORMATION ON ICM

- ICM-LAVegMod
  - Visser et al. (2013)
  - Visser & Duke-Sylvester (2017)
- ICM-Morph
  - Couvillion et al. (2013)

Beautiful day on Mike Island in the Wax Lake Delta (photo: MRFM)

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Thank you for your attention!

Beautiful day on Mike Island in the Wax Lake Delta (photo: MRFM)